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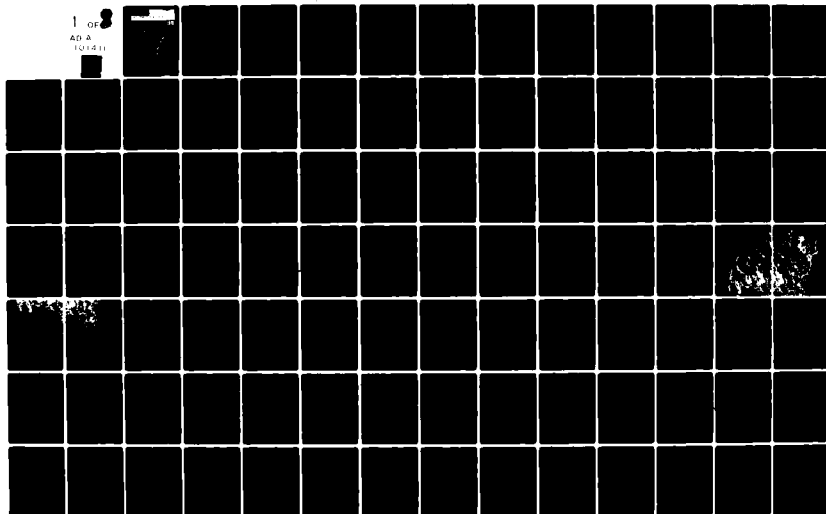
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# WASTEWATER MANAGEMENT STUDY

## APPENDIX III MUNICIPAL WASTEWATER and STORMWATER RUNOFF

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April 10, 1973

Re: Submission of Final Report

Col. Robert L. Moore, District Engineer  
Buffalo District  
United States Army Corps of Engineers  
1776 Niagara Street  
Buffalo, New York 14207

Dear Col. Moore:

We are submitting our final report on the "Wastewater Management Alternatives for the Cleveland-Akron, Three Rivers Watershed Area." The report, entitled a Specialty Appendix to conform to your guidance, consists of four separate volumes - a Summary Report and Three Technical Appendices which were previously submitted as Contract Phase Reports. This submission completes our assignment under Contract Number DACW49-72-C-0048 dated May 9, 1972.

We are pleased to have been chosen to work on this assignment and trust that this report will have meaningful value in completing your overall task.

We are at your convenience to discuss this report or items regarding its development.

Very truly yours,

HAVENS AND EMERSON, LTD.

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BUFFALO DISTRICT

SURVEY SCOPE STUDY  
FOR  
WASTEWATER MANAGEMENT PROGRAM

Contract Summary Report

Prepared B  
HAVENS AND EMERSON, LTD.  
CONSULTING ENVIRONMENTAL ENGINEERS  
Cleveland, Ohio

April 1972

Under Contract No.: DACW49-72-C-0048 ~

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## INTRODUCTION

This Specialty Appendix describes the results of a portion of the Survey Scope Study on Wastewater Management Alternatives for the Cleveland-Akron, Three Rivers Watershed Area. This portion contained herein is related to the water-based treatment of municipal wastewater and stormwater. The industrial waste treatment, land-based treatment, and plan formulation was carried out by others and are the subjects of other specialty appendices. The Specialty Appendices are being combined to form the background for the Survey Scope Study Report.

The Specialty Appendix consists of a Summary Report and Three Technical Appendices. The Technical Appendices contain the details of the work and rationale behind the selection of the basis of design and cost. The Technical Appendices are arranged in a format to conform to the three contract phases. The Summary Report conforms to the guidance provided in the Wastewater Management Program Study Procedure, OCE, May 1, 1972 and is as follows:

### SUMMARY REPORT

- A. Discussion of Technical Goals
- B. Design Criteria
- C. Methodology of Developing Alternatives
- D. Cost Estimations - Methodology and Criteria
- E. Alternatives
- F. Final Alternatives

### TECHNICAL APPENDIX

- ✓ PHASE I - Municipal Wastewater and Stormwater Runoff
- ✓ PHASE II - Systems Design and Estimate of Cost
- ✓ PHASE III - Time Phasing of Selected Alternatives

#### A. DISCUSSION OF TECHNICAL GOALS

The objective of water quality goals is to establish a target for design of treatment processes for municipal wastewater, combined overflow and storm-water runoff. The level of treatment, with a higher level indicating greater degree of treatment, determines the water quality of both the effluent and the resulting quality of the receiving water. As the level of treatment increases, so does the cost. The treatment cost and resulting water quality benefit should be optimized to produce a program with the most favorable cost effectiveness.

In this study, two levels were established - Level 1 to reflect the proposed State Standards (as of June, 1972) and a higher level, Level 2, referred to as the O.C.E. goal. The O.C.E. goal used for this study was established by the letter of June 19, 1972 from the Buffalo District to O.C.E. It was based on the draft goals of May, 1972 but modified to reflect current technological limits. In their report of August 31, 1972, Environmental Quality Systems, Inc. suggested another set of goals which are shown on Tables A1, A2 and A3. The COD concentration of the August goal has been increased from 5 to 10 mg/l to reflect the more usual ratio of BOD-COD in a highly treated effluent. The process scheme developed for Level 2 will satisfy either goal. All of these are shown on Tables A1, A2 and A3 for municipal wastewater, combined overflow, and stormwater runoff respectively, and they are discussed in more detail later. The two levels were established to indicate the cost associated with higher degrees of treatment and a higher degree of receiving water quality. Both levels are higher than the existing levels of water quality, and both levels require tertiary treatment, or unit processes in addition to those commonly employed to treat wastewater or stormwater. Typical treatment processes that would be utilized to meet the standards are discussed with the associated level or goal.

## 1. LEVEL 1

The degree of treatment under this condition would meet the State Standards as proposed in mid-1972. Since those standards were proposed there has been a modification in the technique of applying the criteria which in turn would change the actual limits. However, the treatment processes developed will produce an effluent that will meet the modified criteria. The Level 1 goal for municipal wastewater is shown in Table A1.

The Level 1 goal for combined overflow and stormwater is not as high as for municipal wastewater and is shown also on Tables A2 and A3.

Level 1 goals for municipal wastewater, combined overflow and stormwater can be met with today's technology. The effects of the degree of treatment on receiving water quality should be closely monitored to determine the impact and need for further treatment.

### 1.1 MUNICIPAL TREATMENT PROCESS AND EFFECTIVENESS

Two systems were considered for treating municipal waste - a biological and a physical-chemical. The biological system incorporates specific physical and biological treatment techniques, and is the system most likely to be applied to this area in the near future. Of the population receiving secondary treatment, (about 77 percent of the total), about 93 percent is provided by the activated sludge process or a modification thereof. Consequently, the activated sludge process with an aeration contact time of 5-6 hours is assumed as the one that must be upgraded to meet various wastewater management goals listed in Table A1. More details can be found in Technical Appendix - Phase II report, Part A-1.

### 1.2 BIOLOGICAL SYSTEM - LEVEL 1

The basic biological system adopted for this study consists of screening,

TABLE A1

## MUNICIPAL WASTEWATER CHARACTERISTICS AND GOALS

(Values in mg/l)

Parameter	Influent Quality	Level 1		Level 2	
		Goal	Process Effectiveness	Goal (1)	Goal (2) Process Effectiveness
Suspended Solids	182	8	2	< 5	< 1 Trace
BOD	178	5	4	< 5	< 3 Trace
COD	360	N/A*	26	10	< 10 8
Ammonia Nitrogen		2	Trace	< 1	< .5 Trace
(N <sub>T</sub> ) Total Nitrogen	23.3	N/A	17.2	5	< 3 0.7
Phosphorus (as P)	11.1	0.5	0.5	< .5	< .2 0.1

\*N/A indicates no goal established.

Goal (1) by June 19, 1972 Buffalo District letter

Goal (2) by August 31, 1972 O.C.E. report of Environmental Quality System, Inc., with modified COD goal.

TABLE A2  
COMBINED OVERFLOW CHARACTERISTICS AND GOALS

(Values in mg/l)

Parameter	Influent Quality	Level 1		Level 2	
		Goal	Process Effectiveness	Goal (1)	Goal (2) Process Effectiveness
Suspended Solids	200	N/A*	30	< 5	< 1 1
BOD	60	N/A	10	< 5	< 3 1
COD	220	N/A	50	10	< 10 8
Total Volatile Solids	160	N/A	24	N/A	Trace
Suspended Volatile Solids	120	N/A	18	N/A	Trace
Phosphorus	8	N/A	N/A	0.1	< 2 0.2
Total Nitrogen	12	N/A	N/A	N/A	< 3 2
Chloride	161	N/A	N/A	N/A	161

\*N/A indicates no goal established.

TABLE A3  
STORMWATER RUNOFF CHARACTERISTICS AND GOALS

(Values in mg/l)

Parameter	Influent Urban	Quality Dense Urban	Level 1		Level 2	
			Goal	Process Effectiveness	Goal (1)	Goal (2) Process Effectiveness
Suspended Solids	300	500	N/A*	50	< 5	< 1 1
BOD	20	30	N/A	10	< 5	< 3 1
COD	150	200	N/A		10	< 10 8
Total Volatile Solids	110	140	N/A		N/A	Trace
Suspended Volatile Solids	80	105	N/A		N/A	Trace
Phosphorus	.7	.5	N/A		0.1	< 0.1 < 0.1
Nitrogen	3.1	2.2	N/A		N/A	< 3 0.9
Chloride	160	166	N/A		N/A	166

\*N/A indicates no goal established.

grit removal, primary settling, secondary settling, aeration, and disinfection; with anaerobic sludge digestion followed by vacuum filtration and incineration or landfill. To meet Level 1, biological nitrification, phosphorus removal (using metal salts), additional solids removal by polymer addition and in-depth filtration, and post-aeration are the unit processes added. Solids handling is modified, with the major modification being the addition of sludge thickening and heat conditioning. Priority is placed on disposing of the sludge on strip mined areas.

### 1.3 PHYSICAL-CHEMICAL SYSTEM - LEVEL 1

The physical-chemical system adopted for this study consists of screening, grit removal, a flocculator-clarifier with lime and polymer addition for phosphorous and suspended solids removal, recarbonation to control pH and prevent encrustation of the carbon adsorption system, a filtration system for removal of fine solids, the carbon adsorption system itself, and disinfection. A regeneration system is provided for the carbon, and a recalcination system is provided for the sludge resulting from the flocculator-clarifier. Waste ash is landfilled. To this basic system additional phosphorus and BOD<sub>5</sub> removal must be provided as well as ammonia nitrogen removal to meet Level 1 criteria. To this end, a second stage flocculator-clarifier has been incorporated. Additional phosphorus removal and additional carbon adsorption are added to reduce the refractory organics. Breakpoint chlorination is used for ammonia nitrogen removal in lieu of clinoptilolite because the questions of resin detrition, recovery and reuse, and ultimate disposal of ammonia concentrate would remain. Post aeration would be added. The chlorine contact tank would become a reactor for the breakpoint chlorination process.

### 1.4 COMBINED OVERFLOW TREATMENT PROCESSES AND EFFECTIVENESS - LEVEL 1

There are large areas in Cleveland and Akron that are served by combined

sewer systems. During periods of dry weather, the municipal waste is conveyed to the plant for treatment, but during periods of rainfall, some of the stormwater runoff mixes with the municipal wastewater and is diverted away from the plant and is discharged directly to receiving waters without treatment.

Table A2 indicates the quality of overflow considered in the design of the process, and the process effectiveness. Details can be found in the Technical Appendix, Phase I and Phase II, Part B on the quality and quantity of combined overflow.

Since stormwater runoff and combined overflows are intermittent, have high peak flows, and have a widely varying quality, a feasible treatment process requires storage basins which absorb the peak rates, decrease the required size of the treatment units, and standardize the quality. The storage and treatment facilities are designed to treat the one year stormwater runoff resulting from a 1 year, 6 hour duration rainfall. In a combined system the storage basins will be constructed of concrete with sludge collectors. The sludge will be piped to the closest wastewater treatment plant for ultimate disposal.

Flows in excess of the one-year storm would receive screening, settling and disinfection prior to discharge.

The volume in the storage basin is dependent upon the treatment scheme. In the scheme where treatment is provided at the storage site, the storage cost and treatment cost were optimized for a generalized case which indicated the treatment units should be capable of treating about 30% of the peak flow. The remainder of the inflow would be stored and treated at the maximum rate until the basin is empty. In the alternate scheme, combined overflow is stored in a concrete basin designed to hold the entire runoff volume of the 1 year, 6 hour duration storm with a pump out rate sized to empty the basin in three days. The polluted overflow from storage is discharged into the

closest interceptor sewer and conveyed to a municipal wastewater treatment plant for treatment. Sludge is also pumped to the wastewater treatment plant.

The treatment provided in the latter scheme has the same effectiveness as that provided for the municipal waste. In the former scheme where the treatment facilities are at the storage site, the unit processes consist of coarse screening, storage and sedimentation, microstraining, and disinfection by ozonation. This particular scheme has been adopted because it can respond quickly to a start up condition, or to changes in flow, and further, capital cost items are minimized in favor of higher flow dependent operating cost items.

#### 1.5 STORMWATER RUNOFF TREATMENT PROCESSES AND EFFECTIVENESS - LEVEL 1

Stormwater runoff contains a pollution load that results from natural sources as well as those from man's use of the land. The quality and quantity of the load is influenced by the type of land use, density of population, type of sewer system, hydrology, and several other factors. Table A3 summarizes the stormwater quality as it is presented in the Technical Appendix, Phase I, Part B-6.

As with combined overflows, stormwater flows are intermittent, have high peaks, and vary widely in quality. Similarly, the treatment processes follow the same techniques. Storage and treatment are designed to treat the one year, 6 hour duration storm flow in areas where storage and treatment are combined at one location. The treatment scheme is designed specifically for stormwater. Storage may be in earth or concrete basins depending upon available land. In areas where the storm sewers are known to be heavily cross-connected with the sanitary system or in densely developed urban areas, preference was given to concrete basins. For these basins, storage and treatment was optimized as it was for the combined overflow treatment. When the stormwater is treated on site in concrete basins, all of the sludge is collected

and transported to the closest wastewater plant. When earth basins were used, the storage-sedimentation basin sludges were assumed to be removed periodically and taken to landfill.

In areas where the storage can be developed close to a treatment plant and the plant is used for treating the storm water, the storage volume provided is equivalent to 20 percent of the total annual runoff, which coincidentally is about equal to the 100 year storm runoff. A 30-day pump out rate was used. This is discussed in the Technical Appendix, Phase II, Part B-2.

Stormwater treatment to achieve the Level 1 goals consists of pretreatment, storage and sedimentation followed by microstraining and disinfection. These plants would be highly automated to respond rapidly to changes in flow.

## 2. LEVEL 2

Level 2 is based upon the national goal identified in the Federal Water Pollution Control Act Amendments of 1972, "... that the discharge of pollutants into the navigable waters be eliminated by 1985." The Office of the Chief of Engineers, Department of the Army (O.C.E.) established technical goals for this study commensurate with that national goal, i.e., (1) prevent the continued degradation of our water resources by waterborne wastes and (2) to provide for the efficient reuse of treated or renovated wastewater and by-products.

The technical goals were translated into effluent criteria by O.C.E., consisting of the most stringent constituent levels from among those required for public water supply, irrigation water, livestock water, and aquatic habitat. Those criteria are referred to as the O.C.E. Goals. The O.C.E. Goals should not be interpreted as effluent standards established by the Federal Government, but rather the translation by the Corps of Engineers of

the stated national objective into a set of consistent guidelines for all similar wastewater management studies throughout the nation.

The Level 2 criteria was applied to both municipal wastewater and stormwater so that both processes would produce an equal effluent.

Municipal, combined sewer overflow and stormwater treatment processes and their effectiveness will be discussed in this section.

#### 2.1 MUNICIPAL TREATMENT PROCESS AND EFFECTIVENESS

As with Level 1, two systems, a biological and a physical-chemical process, were considered.

#### 2.2 BIOLOGICAL SYSTEM - LEVEL 2

The biological system for Level 2 goals consists of additional unit processes added to the Level 1 scheme. The goals and effectiveness values are shown on Table A1.

To meet the Level 2 goals, biological denitrification, additional phosphorous removal, and carbon adsorption for refractory organics are unit processes added to the Level 1 system. The solids handling remains the same, again with emphasis placed on disposal on strip mined areas.

#### 2.3 PHYSICAL-CHEMICAL SYSTEM - LEVEL 2

The physical-chemical system for Level 2 goals consists of an additional unit process attached to Level 1. The goals are shown on Table A1.

To meet the Level 2 goals, ozonation is added to reduce the refractory organics and further polish the effluent. The post aeration facilities would be modified for the ozonation systems facilities.

#### 2.4 COMBINED OVERFLOW TREATMENT PROCESSES AND EFFECTIVENESS - LEVEL 2

To meet the Level 2 goals for combined overflow requires unit processes

similar to the municipal treatment processes. As with the Level 1 program, two situations exist - one with storage and treatment at the site; and two, storage with treatment at a municipal plant.

The hydraulic capacity of the treatment facilities and storage are the same as with the Level 1 scheme. The treatment facilities are modified by adding breakpoint chlorination for nitrogen removal and downflow dual media granular activated carbon-sand filters to provide further soluble organic removal. A rapid mix and flocculation facility have been provided prior to the storage and sedimentation basin to increase organics and phosphorous removal. Ozonation is used for final organic polishing prior to release into the receiving body of water. More details are provided in the Technical Appendix, Phase II, Part B-1.

#### 2.5 STORMWATER RUNOFF TREATMENT PROCESSES AND EFFECTIVENESS - LEVEL 2

Treatment of separate stormwater to meet the Level 1 goals is largely a reduction of particulate solids and disinfection. However, to meet the Level 2 goals, these reductions must be increased; soluble organics must be reduced; and phosphorous removal must be included.

The pretreatment, storage, and sedimentation are the same processes as in the Level 1 scheme. Powdered activated carbon is added for removal of soluble organics; its use was selected to minimize the granular activated carbon inventory and carbon contact time. Alum and a polymers are used to increase solids removal and reduce phosphorous. Ozonation is provided for disinfection and final organic polishing. Additional details are discussed in Technical Appendix, Phase II, Part B-1.

## B. DESIGN CRITERIA

Detail design criteria is presented in the Phase I and II reports of the Technical Appendices. This section will summarize the data used to formulate the alternatives.

### 1. BASIC DATA

During the Phase I portion of the study, the basic data such as population, flows, land use, existing facilities, and planned programs were gathered. Much of this data had been gathered during the feasibility study and only required updating. Population data was available from the 1970 census and recent projections made by the Battelle Institute for the Northeast Ohio Water Development Plan. Several areas were adjusted to meet the expectations of the local planners. The land use was determined by discussion with local planning agencies and conforms closely to the land use used for the Northeast Ohio Water Development Plan Study. This projected land use concept would exist in 1990 according to the local planners; however, the densities would be on the lower side of the given ranges. The land use map indicates only general categories and ranges of population density.

### 2. MUNICIPAL WASTEWATER

Collection systems that are existing were examined for ultimate capacity and adaptability to plan variations. Proposed systems were designed for 2020 flows with 150 gpcd and a peaking factor of 2-4 depending upon the population. Industrial waste flows were added. All collection system components were designed for the ultimate flow or 2020. Useful lives of the various components vary from 20 to 50 years. Part A-2 of the Phase II report discusses loading ratios, useful lives, and detailed design criteria. Section A of this summary report refers to the unit process details.

### 3. STORMWATER RUNOFF

The design criteria for layout and the engineering features for the stormwater collection system are similar to the collection system for the municipal waste. Existing systems were compared to the design storm peak flows and for their adaptability to plan variations. The pipes were designed for the 1 year - 6 hour peak flow based on a runoff situation that was assumed to exist in 2020. Over the basin, this runoff averages 0.5 cfs per acre. The volume of runoff was taken from the hydrograph. As a basin average, the runoff is 1.25 inches, compared to the 3.6 inches of rainfall in the design storm. The design criteria for the storage and treatment are discussed in Section A of this summary report and Technical Appendix, Phase II, Part B.

### C. METHODOLOGY OF DEVELOPING ALTERNATIVES

Alternatives for managing the municipal wastewater and stormwater runoff were formulated to indicate degrees of optimization due to regionalism and to show the cost of higher degrees of treatment. As discussed in Section A, two levels of treatment were selected to indicate the cost of higher degrees of treatment, and eight of the twelve alternatives were formulated and costed to both levels for this purpose. Table C1 lists the alternatives. In developing the alternatives, the goals of Section A and the design criteria of Section B were utilized. In this section municipal wastewater and stormwater runoff are discussed separately.

#### 1. MUNICIPAL WASTEWATER

The twelve alternatives were formulated by the plan formulation contractor. The plant locations were provided as part of the formulated plan. Using the land use map and topographic maps, a preliminary interceptor pattern was laid out to serve the sewerage district for each plant. In established areas, the existing systems were reviewed for adequacy.

If a plant was existing, its capabilities were reviewed, and modifications were proposed to enlarge and increase its capabilities to meet the Level 1 or 2 goals as necessary.

For the initial twelve alternative plans, the methodology of comparison was to design and estimate cost of the plant capable of handling the 2020 flow immediately or as it was programmed to be phased into the plan. This, of course, is done only for comparison, and it actually would not be completed in this fashion.

The comparative capital cost then became the cost of constructing the plant with a design flow capability of 2020 to either Level 1 or Level 2

TABLE C1  
LIST OF ALTERNATIVES

<u>Plan</u>	<u>Level</u>	<u>Brief Description</u>
1	1	All water based - separate storm
1	2	water treatment
2	1	All land - separate storm water
2	2	treatment
3	1	All water with storm water
3	2	taken to municipal plant
4	1	All land with storm water
4	2	taken to municipal plant
5	1	Combination - heavy water
5	2	Combination - heavy water
6	1	Combination - heavy land
6	2	Combination - heavy land
7	1	Combination - heavy water
7	2	Combination - heavy water
8	1	Combination - heavy land
8	2	Combination - heavy land
9	2	Combination - heavy land - massive regionalization
10	2	Similar to Plan 3. All municipal plants - advanced biological
11	2	Similar to Plan 3. All municipal plants - physical-chemical
12	2	Similar to Plan 4. All secondary treatment with aerated lagoons

depending upon the plan. The present worth of any existing structures was included in determining the total capital cost. If new interceptors or pumping stations were needed, they too were added to the capital cost. All interceptors and pumping stations were designed for the 2020 flow conditions.

The unit processes used to meet the goal depended upon the plan and its level of treatment. In the plans where the wastewater was applied to land treatment, the prior processes included primary and secondary treatment with disinfection. In those plans where the effluent was finally discharged into a waterway, then tertiary treatment, disinfection and nutrient removal or reduction was considered. The unit processes used are described in detail in the Technical Appendix, Phase II, Part A. All twelve alternative plans were compared using the same methodology. The plan formulation methodology and land treatment methodology will be discussed by the appropriate contractor.

In the Phase III portion of the study, three of the twelve alternative plans, (1, 7, and 8) were designated for further investigation. Slight modifications were made to these plans, and they are referred to as Plans A, B and C for the Phase III work. The three plans were reviewed by the Corps of Engineers prior to final cost phasing.

The cost comparison and methodology for the final selected plans was made in more detail. Again, if plants existed, their present worth was considered. All final plants were increased in capabilities by a reasonable phasing program to 2020 flow conditions adequate for Level 2 effectiveness. Since the majority of plants are secondary activated sludge, it was necessary to include tertiary units. In all water based plant schemes, the plant capability was increased to meet Level 1 goals prior to 1983, and Level 2 goals by 1985. The first modifications between 1972 and 1983 would be a Level 1 unit process addition. The design years for capacity were 1990 and 2020. The second

modification would be between 1983-1985, to a Level 2 standard. All enlargements after 1985 would be to Level 2 standards. This is discussed in more detail in the Phase III report.

Industrial waste flows compatible with the municipal treatment were added to the municipal wastes for treatment. In the cases of non-compatible industrial wastes, pretreatment would be accomplished at the source to provide a compatible effluent. Both industrial waste flow rates and pretreatment processes were developed by another contractor.

## 2. STORMWATER

The twelve alternative plans were developed using treatment goals and processes discussed in the preceding sections of this appendix. In developing the alternatives, the study area was divided into storm drainage districts based on topographic considerations. The time at which each district would be developed to a degree that storm drains could be installed was estimated and a preliminary storm drainage pattern was established for those areas not now served by storm drains or combined sewers.

The basin data for each drainage district was gathered and a generalized unit hydrograph was applied using a 1 year - 6 hour duration rainfall. All of the background data for the watersheds and the rationale can be found in the Technical Appendix, Phase I, Part B.

With the flow hydrograph for each basin established, and a general pattern of the storm drainage either existing or proposed, as the case may be, the collection system pipe sizes were established, and an area was selected for the treatment site. Depending upon the area and plan level, the method of treatment was chosen, and costs were estimated. Opportunities for consideration of drainage districts into regional systems were considered and optimized.

In selecting the method of treatment, several alternatives were estimated.

In combined sewer areas, the selection was narrowed somewhat, as only concrete storage basins were considered. The question of whether to treat on-site or to pump to a wastewater treatment plant was also investigated. Sludge from the combined sewer areas was taken to a wastewater treatment plant for disposal, in all cases.

In separate sewered areas, the stormwater runoff was stored in earth basins or concrete basins depending upon available land and local conditions. In the drainage districts where storm drains have been installed and the system is known to be highly interconnected with the sanitary sewers, and where space is at a premium the concrete basin was used. In newer suburbs, earth basins were considered. As areas develop and storm drains are installed, earth basins would be incorporated into the basic subdivision planning process. Also in the newer areas, the volume of runoff would be reduced because of imposed zoning constraints. It has been assumed that as new areas develop legislation will require some degree of upstream storage and that planned unit development will reduce the runoff. The storage-treatment processes are described in Section A of this report.

#### D. COST ESTIMATION METHODOLOGY AND CRITERIA

Each alternative plan is composed of various combinations of treatment units to achieve the designated goals. These combinations, as previously described, include advanced biological treatment, physical-chemical treatment, and land treatment of municipal wastewater; on-site storage and treatment, storage and treatment at the municipal plant, and storage plus land treatment of the combined sewer overflow and separate stormwater runoff. It is the purpose of this section to present the methodology and criteria used in preparing cost estimates of the alternative plans, with specific attention given to the various treatment techniques.

As previously discussed, this specialty appendix deals only with water-based treatment and stormwater runoff treatment. All costs associated with land treatment were done by the land treatment contractor.

##### 1. UNIT COSTS

The treatment schemes proposed are combinations of various treatment units to achieve the level of treatment desired. Capital cost curves and operation and maintenance cost curves were developed therefore for each of these treatment units (e.g. carbon adsorption, microstrainers, vacuum filters, gravity sewers, etc.). These curves are presented in the Technical Appendix, Phase II report along with design parameters and cost data references. These unit costs were developed for the treatment units of the municipal wastewater plant as well as the stormwater water treatment plant. An ENR construction cost index of 1740 was used to relate assumed price levels.

## 2. COMPOSITE COSTS

In order to expedite costing of the alternative plans, composite cost curves were developed for each of the treatment schemes. The capital cost curves and operation and maintenance costs curves of the treatment units specified in a particular treatment scheme were used in the development of the composite curves.

### 2.1 MUNICIPAL WASTEWATER

There were five wastewater treatment plant variations for which composite cost curves were developed. These include:

1. Preliminary treatment plant
2. Conventional activated sludge plant
3. Advanced biological plant - Level 1
4. Advanced biological plant - Level 2
5. Physical-chemical plant - Level 2

The physical-chemical plant was the only wastewater treatment composite curve which included sludge handling. There were four sludge disposal variations for which composite curves were developed. These included:

1. Strip mine application
2. In-basin agricultural application
3. Incineration
4. Ash disposal

The composite cost curves discussed above are presented in the Technical Appendix, Phase II, Part A-4, along with a detailed description of design parameters.

## 2.2 STORMWATER

The composite cost curves developed for stormwater treatment accounted for variations in type of stormwater (combined versus separate), type of storage (earth versus concrete), and level of treatment. The treatment schemes included:

1. Separate stormwater with earth basin - Level 1.
2. Separate stormwater and combined sewer overflows with concrete basins - Level 1.
3. Separate stormwater with earth basin - Level 2.
4. Separate stormwater with concrete basin - Level 2.
5. Combined sewer overflows with concrete basin - Level 2.

These composite cost curves are presented in the Technical Appendix, Phase II, Part B-3, along with a detailed description of design parameters.

## 3. PHASE II COST PROCEDURE

Twelve alternative plans were formulated in the Phase II portion of this Survey Scope Study. These plans are described in detail by the Plan Formulation contractor in his report and will not be duplicated here. The cost estimation of these plans was developed to provide an economic comparison of the plans to each other. The costs associated with these plans do not directly reflect the actual cost and were not intended to do so. These costs were used to provide the economic evaluation of the 12 plans in selecting the three plans to be further investigated in Phase III.

The procedure for the cost estimation includes the calculations of the following items for each of the major segments involved.

1. Net capital cost - This cost is based on the 2020 design flows and takes into account the present worth of the existing structures.
2. Annual capital - This cost is based on a capital recovery factor multiplied by the net capital cost. The capital recovery factor is a function of the useful life of the item and an interest rate of 7%.
3. Operation and maintenance - This cost is based on the 2020 design flow of the particular segment.
4. Annual comparative value - This is the summation of the annual capital and the operation and maintenance.

The annual comparative value was used as the basis of the economic comparison. Section C of the Phase II Technical Appendix presents a detailed breakdown of these costs for each plan by the following category: wastewater-liquid phase, wastewater-solid phase, stormwater-liquid phase, and stormwater-solid phase.

Section E of this report summarizes the costs for Plans 1 through 12 as developed for the wastewater and stormwater portion of the cost estimation. It should be noted that the cost summaries as presented here are not the entire plan costs in that they include no cost for land treatments of wastewater, stormwater, or sludge and no cost for industrial waste pretreatment. Total cost can be found in report of the Plan Formulator.

#### 4. PHASE III COST PROCEDURE

In the Phase III portion of the Survey Scope Study, three of the twelve alternative plans were investigated in more detail. The plans selected were Plans 1, 7 and 8. Slight modifications of the original plans were made to optimize the plans, which were re-designated Plans A, B and C respectively.

The costing procedure of Phase III provided a solid economic comparison of the three plans using a present worth technique. This technique is described in detail in the Technical Appendix, Phase III. Section F addresses the cost for the municipal wastewater and the stormwater portion of Plans A, B and C. A more detailed breakdown for each municipal plant and drainage district of each plan is also presented in the Technical Appendix, Phase III. It should be noted again that the cost summaries as prescribed here are not the entire plan costs in that they include no cost for land treatment of wastewater, stormwater or sludge and no cost for industrial waste pretreatment, and the total cost can be found in the report of the Plan Formulator.

## E. ALTERNATIVES

In Phase II of this survey scope study twelve alternative plans were developed as wastewater management alternatives for the Cleveland-Akron Three Rivers Watershed Area. Detailed descriptions of these plans are presented in the Plan Formulators Phase II report and in Technical Appendix Phase II.

### 1. COST ESTIMATION

The methodology used in the development of these plans and the cost estimation of these plans are described in Section C and Section D of this report, respectively. Table E1 shows the results of the cost estimation in terms of Annual Comparative Values. These cost coupled with the costs from the land treatment contractor were used as the bases of the economic comparison of the twelve alternative plans.

### 2. ELECTRICAL POWER AND CHEMICAL REQUIREMENTS

Estimates were made of the electrical power requirements and chemical requirements of the municipal wastewater plants. Table E2 summarizes these results for the twelve alternative plans. This information was required to provide data essential for evaluation of the plans. Additional information is provided with Technical Appendix, Phase II.

TABLE E1  
ANNUAL COMPARITIVE VALUES\*  
(\$1,000,000/Yr.)

<u>Plan</u>	<u>Level</u>	<u>Wastewater</u>		<u>Stormwater</u>		<u>TOTAL</u>
		<u>Liquid</u>	<u>Solid</u>	<u>Liquid</u>	<u>Solid</u>	
1	1	68	15	87	7	177
1	2	99	16	143	10	268
2	1	43	6	87	7	143
2	2	43	6	143	10	212
3	1	72	12	203	7	294
3	2	104	13	220	9	346
4	1	44	6	157	5	212
4	2	44	6	157	6	213
5	1	70	12	125	9	216
5	2	103	13	169	12	297
6	1	56	9	124	9	198
6	2	73	10	165	12	260
7	1	75	11	137	6	229
7	2	97	12	150	7	266
8	1	50	9	131	6	196
8	2	59	9	139	8	215
9	2	59	7	198	5	269
10	2	104	10	220	7	341
11	2	116	1	214	1	332
12	2	7	-	115	6	128

\*These costs include no costs associated with land treatment.

TABLE E2  
MUNICIPAL PLANTS IN 2020  
ELECTRICAL POWER AND CHEMICAL REQUIREMENTS\*

<u>Plan</u>	<u>Level</u>	<u>Electrical Power Requirements (MEGAWHR/DAY)</u>	<u>Chemical Requirements (TONS/DAY)</u>
1	1	2040	237
2	1	1730	58
3	2	2460	416
4	2	1730	58
5	1	2791	222
6	1	1926	143
7	2	2171	404
8	2	1900	142
9	2	1200	266
10	2	2460	416
11	2	2460	962
12	2	557	0

\*These figures include no requirements associated with land treatment.

## F. FINAL ALTERNATIVES

In Phase III of this survey scope study, Plans 1, 7 and 8 of the original twelve alternative plans were investigated in more detail. Modifications were made to optimize these plans which were re-named Plans A, B and C. Detailed description of these plans are presented in the Plan Formulators Phase III. Subsequent to development of these three plans it was determined that Plan A, which had been designed to achieve Level II criteria, should also be designed and cost estimated to achieve Level I criteria. This effort was accomplished and is discussed in more detail in Appendix D of the Phase III report of this consultant's effort. (See Appendix III, Municipal Wastewater and Stormwater Runoff appendix of total Wastewater Management Report)

### 1. COST ESTIMATION

The methodology used in the development of these plans and in the cost estimation of these plans are described in Section C and Section D of this report, respectively. The results of the present worth costing technique are shown in Table F1. These costs, coupled with the costs from the land treatment contractor, will be used as the basis of the economic comparison of the plans. For information, the annual costs by decade were computed to provide data of value to the evaluators. A summary of these costs are shown in Table F2.

### 2. ELECTRICAL POWER AND CHEMICAL REQUIREMENTS

Estimates were made of the electrical power requirements and chemical requirements of the municipal wastewater plants and stormwater plants. Table F3 summarizes these results for the three final alternative plans. Additional information is provided in the Technical Appendix, Phase III.

TABLE F1

SUMMARY

TOTAL PRESENT WORTH \*

(\$1,000)

	<u>Capital</u>	<u>O &amp; M</u>	<u>Land</u>	<u>Total</u>
<u>PLAN A **</u>				
Municipal	450,893	628,540	4,149	1,083,602
Stormwater	<u>686,314</u>	<u>135,100</u>	<u>7,376</u>	<u>828,606</u>
Total	1,137,207	763,640	11,525	1,912,208
 <u>PLAN B</u>				
Municipal	397,891	585,050	3,970	986,919
Stormwater	<u>644,866</u>	<u>127,377</u>	<u>7,496</u>	<u>779,800</u>
Total	1,042,757	712,427	11,466	1,766,719
 <u>PLAN C</u>				
Municipal	262,764	397,331	2,190	661,290
Stormwater	<u>401,637</u>	<u>89,119</u>	<u>7,556</u>	<u>498,373</u>
Total	664,401	486,450	9,746	1,159,663

\* These costs include no costs associated with land treatment.

\*\* Data presented relates to Plan A to Level II as displayed in the Phase III report prepared by this consultant; comparison of Plan A to Level I vs Plan A to Level II is displayed in Appendix D, of this consultant's Phase III report.

TABLE F2

SUMMARY

TOTAL ANNUAL COST \*

(\$1,000/YEAR)

	<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>PLAN A **</u>								
Municipal	30,245	55,952	62,964	91,229	113,946	137,887	143,849	150,620
Stormwater	<u>0</u>	<u>27,243</u>	<u>60,276</u>	<u>82,375</u>	<u>109,170</u>	<u>122,435</u>	<u>124,647</u>	<u>126,120</u>
Total	30,245	83,195	123,240	173,604	223,116	260,322	268,496	276,740
<u>PLAN B</u>								
Municipal	30,897	52,168	58,642	84,127	101,301	123,852	128,346	133,456
Stormwater	<u>0</u>	<u>27,246</u>	<u>58,921</u>	<u>78,309</u>	<u>101,063</u>	<u>109,576</u>	<u>111,320</u>	<u>112,303</u>
Total	30,897	79,414	117,563	162,436	202,364	233,428	239,666	245,759
<u>PLAN C</u>								
Municipal	30,743	50,813	57,926	60,891	57,776	55,331	37,770	31,985
Stormwater	<u>0</u>	<u>18,212</u>	<u>40,933</u>	<u>49,063</u>	<u>62,596</u>	<u>69,212</u>	<u>69,430</u>	<u>70,198</u>
Total	30,743	69,025	98,859	109,954	120,372	124,543	107,200	102,183

\* These cost include no costs associated with land treatment.

\*\* Data presented relates to Plan A to Level II as displayed in the Phase III report prepared by this consultant; comparison of Plan A to Level I vs Plan A to Level II is displayed in Appendix D of this consultant's Phase III report.

TABLE F3  
MUNICIPAL AND STORMWATER PLANTS  
ELECTRICAL POWER AND CHEMICAL REQUIREMENTS \*

	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>PLAN A **</u>					
CHEMICAL (TONS/DAY)	215	449	508	562	611
ELECTRICAL (MEGAWHR/DAY)	1362	1788	2028	2229	2414
 <u>PLAN B</u>					
CHEMICAL (TONS/DAY)	203	423	476	526	566
ELECTRICAL (MEGAWHR/DAY)	1282	1692	1877	2038	2174
 <u>PLAN C</u>					
CHEMICAL (TONS/DAY)	175	88	109	97	107
ELECTRICAL (MEGAWHR/DAY)	1337	1328	1317	891	973

\* These figures include no requirements associated with land treatment.

\*\* Data presented relates to Plan A to Level II as displayed in the Phase III report prepared by this consultant; comparison of Plan A to Level vs Plan A to Level II is displayed in Appendix D of this consultant's Phase III report.

SURVEY SCOPE STUDY  
FOR  
WASTEWATER MANAGEMENT PROGRAM

Contract Phase Report  
Phase I  
Municipal Wastewater  
and  
Stormwater Runoff

Havens and Emerson, Ltd.  
Consulting Environmental Engineers  
Contract No.: DACW49-72-C-0048  
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## INTRODUCTION

This Survey Scope Study is a continuation of the preliminary work performed under the Feasibility Study in 1971. The Cleveland-Akron area was chosen by the Corps of Engineers as one of five pilot areas in which to develop a wastewater management program. Three consulting engineering firms have been selected to work with the Corps in developing the Cleveland-Akron Survey Scope Study.

This report covers Phase I of the study, and identifies the wastewater management problem with respect to domestic and stormwater runoff wastewater as it exists today and as it is anticipated to exist in the future.

This data is presented by items as described in Phase I of the scope of work. This Phase I report is in the nature of a progress report, and although the data presented herein is complete, it is subject to minor modification and correction in the final report.

## A - MUNICIPAL WASTEWATER

1. Demography - Population projections have recently been made for the Northeast Ohio Water Development Plan. In general, this data provided the source of population figures, which have been reviewed and adjusted in a few areas. The 1970 population estimates were adjusted to the 1970 census data, and the projections were made by the same percentage increases as in the data source. Several areas were varied from the data source to more closely conform to the expectations of the local planners. Specifically, Medina County and the central Cuyahoga Basin were adjusted upwards to reflect a higher growth pattern than projected in the NEOWD Plan. Table A-1-2 lists the population projections by county, city, village, and townships by decade through the year 2020.

The population projections were made in conjunction with the land use maps, and could be substantially altered in the future by a change in the growth philosophy of the local governmental bodies affecting land use.

The 1960-1970 population change in Ohio amounted to an increase of 9.7%. This entire gain was due to natural increase, that is, the difference between births and deaths. The net migration, (the difference between those who moved in and those who moved out of Ohio) between 1960 and 1970 was a negative number, meaning that more people moved out than moved in. Whereas Ohio as a whole experienced a net increase of 9.7%, the counties in the study area exhibited a much more dramatic change. For example, Portage County increased in population by 37.1%, making it the most rapidly growing county. Geauga County was second with an increase of 32.7%; Lake County was third with an increase of 32.6% and Medina County was sixth with a growth of 26.4%. Cuyahoga and Summit Counties had growths of 4.5% and 7.6% respectively. Table A-1-1 tabulates these population changes.

TABLE A-1-1  
POPULATION CHANGE BY COUNTY  
(1960 - 1970)

<u>County</u>	<u>1960</u>	<u>1970</u>	<u>% Gain</u>
Cuyahoga	1,647,895	1,721,404	4.5
Geauga	47,573	63,125	32.7
Lake	148,700	197,154	32.6
Lorain	217,500	256,843	18.1
Medina	65,315	82,583	26.4
Portage	91,798	125,868	37.1
Summit	513,569	552,498	7.6
Ohio (State)	9,706,397	10,652,017	9.7

TABLE A-1-2  
CORPS OF ENGINEER'S SURVEY SCOPE STUDY  
POPULATION DATA

	<u>1970*</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>Cuyahoga County</u>	1,721,404	1,842,070	2,192,050	2,393,720	2,519,800	2,523,000
<u>Cities</u>						
Bay	18,163	22,200	24,000	24,100	24,200	24,300
Beachwood	9,631	12,600	15,400	17,400	18,500	18,600
Bedford	17,552	20,500	23,900	26,401	27,800	27,800
Bedford Heights	13,063	19,200	24,400	28,100	30,100	30,300
Berea	22,396	27,600	33,000	36,900	39,100	39,100
Brecksville	9,137	14,200	18,200	20,300	22,100	22,600
Broadview Heights	11,463	15,600	19,300	21,900	23,400	23,600
Brooklyn	13,142	15,800	18,700	20,800	21,900	21,900
Brook Park	30,774	42,900	54,100	62,000	66,400	66,900
Cleveland	750,903	738,900	788,400	833,100	856,600	846,000
Cleveland Heights	60,767	66,200	74,200	80,500	83,900	85,500
East Cleveland	39,600	44,100	50,200	54,900	57,400	57,200
Euclid	71,552	84,500	98,400	108,700	114,400	114,300
Fairview Park	21,681	27,000	32,200	36,000	38,000	38,100
Garfield Heights	41,417	47,200	54,200	59,500	62,400	62,300
Highland Heights	5,926	8,300	10,300	11,800	12,600	12,700
Independence	7,034	9,000	12,000	15,000	18,000	21,000
Lakewood	70,173	79,300	90,800	99,500	104,300	104,000
Lyndhurst	19,749	23,500	27,500	30,500	32,100	32,100
Maple Heights	34,100	39,100	45,000	49,400	51,800	51,700
Mayfield Heights	22,139	29,200	35,800	40,500	43,100	43,300
Middleburg Heights	12,367	16,500	20,300	23,000	24,500	24,600
North Olmsted	34,861	49,000	61,500	70,300	75,200	75,700
North Royalton	12,807	16,100	19,300	21,700	23,000	23,000
Parma	100,216	120,000	141,200	156,800	165,300	165,400
Parma Heights	27,192	34,000	41,200	46,400	49,400	49,400
Pepper Pike	5,933	6,500	8,100	9,400	10,900	11,000
Richmond Heights	9,220	12,100	14,900	17,000	18,100	18,200
Rocky River	22,958	28,000	33,200	37,000	39,100	39,200
Seven Hills	12,700	18,300	23,000	26,300	28,200	28,400
Shaker Heights	36,306	39,800	44,900	48,800	50,900	50,700
Solon	11,519	15,700	19,500	22,200	23,600	23,800
South Euclid	29,579	33,800	38,800	42,600	44,600	44,500
Strongsville	15,182	20,400	25,300	28,700	30,600	30,800
University Heights	17,055	18,000	20,300	22,000	23,000	22,800
Warrensville Heights	18,925	25,600	31,600	35,900	38,300	38,500
Westlake	15,686	22,000	29,000	36,000	44,000	50,000
<u>Villages</u>						
Bentleyville	338	400	400	500	500	500
Bratenahl	1,613	3,000	5,000	6,000	7,000	8,000
Brooklyn Heights	1,527	1,700	1,900	2,100	2,200	2,200
Chagrin Falls	4,848	6,200	7,400	8,300	8,800	8,900
Cuyahoga Heights	866	1,000	1,100	1,200	1,200	1,200

\*Actual 1970 Census Data

POPULATION DATA (Cont'd.)

<u>Cuyahoga County</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>Villages (Cont'd.)</u>						
Gates Mills	2,378	3,000	3,700	4,100	4,400	4,400
Glenwillow	526	600	700	700	700	700
Hunting Valley	673	1,200	2,000	2,400	2,800	3,200
Linndale	145	200	200	200	200	200
Mayfield	3,550	4,800	5,900	6,700	7,200	7,200
Moreland Hills	3,000	3,900	4,500	5,000	5,300	5,300
Newburg Heights	3,396	3,600	4,100	4,400	4,600	4,500
North Randall	1,212	1,600	2,000	2,300	2,400	2,500
Oakwood	3,127	3,000	3,300	3,400	3,500	3,400
Olmsted Falls	2,504	3,000	3,500	3,800	4,000	4,000
Orange	2,112	2,400	2,800	3,000	3,200	3,200
Valley View	1,422	2,000	2,400	3,000	3,500	4,000
Walton Hills	2,508	3,500	4,200	4,700	5,200	5,500
West View	2,523	3,500	4,300	4,900	5,200	5,300
Woodmere	976	1,500	1,900	2,200	2,400	2,400
<u>Townships</u>						
Chagrin Falls	84	170	250	320	400	500
Olmsted	6,318	5,800	5,800	6,000	6,000	6,000
River Edge	632	600	600	600	600	600
Warrensville	2,160	2,000	2,000	2,000	2,000	2,000
 <u>Geauga County</u>	 63,125	 90,300	 126,400	 166,900	 204,000	 230,600
<u>Villages</u>						
Aquilla	389	600	800	1,000	1,200	1,400
Burton	1,214	1,600	2,000	2,600	3,100	3,500
Chardon	3,991	5,500	7,500	9,800	11,900	13,500
Hunting Valley (Part)	124	200	300	300	400	400
Middlefield	1,726	2,500	3,500	4,500	5,500	6,200
South Russell	2,673	4,500	6,800	9,200	11,400	13,100
<u>Townships</u>						
Auburn	1,517	2,300	3,200	4,200	5,100	5,800
Bainbridge	7,038	10,000	14,500	19,400	23,700	26,800
Burton	2,366	3,400	4,800	6,200	7,600	8,600
Chardon	3,180	4,500	6,300	8,300	10,200	11,500
Chester	10,400	14,800	20,500	27,100	33,000	37,300
Claridon	2,124	3,000	4,200	5,600	6,800	7,700
Hambden	2,500	3,500	4,900	6,500	8,000	9,000
Huntsburg	1,792	2,600	3,600	4,700	5,800	6,500
Middlefield	2,738	3,900	5,400	7,200	8,800	9,900
Montville	1,307	1,900	2,600	3,400	4,200	4,700
Munson	3,569	5,100	7,100	9,400	11,500	12,900
Newbury	4,038	5,700	8,000	10,600	12,900	14,600

POPULATION DATA (Cont'd.)

<u>Geauga County</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>Townships (Cont'd.)</u>						
Parkman	2,084	3,000	4,200	5,500	6,700	7,600
Russell	4,669	6,700	9,300	12,300	15,000	17,000
Thompson	1,834	2,600	3,600	4,800	5,900	6,600
Troy	1,652	2,400	3,300	4,300	5,300	6,000
 <u>Lake County</u>	 197,154	 268,600	 369,200	 464,100	 547,100	 600,300
<u>Cities</u>						
Eastlake	19,690	26,600	41,800	53,600	63,800	70,400
Mentor	36,900	56,300	80,400	103,500	123,600	136,600
Mentor-on-the-Lake	6,517	10,500	15,400	20,000	24,000	26,500
Painesville	16,536	19,300	23,900	28,700	33,000	35,800
Wickliffe	21,354	29,400	40,000	50,500	59,600	65,500
Willoughby	18,634	24,700	32,900	41,000	48,200	52,800
Willowick	21,237	26,900	34,800	49,800	49,900	54,500
<u>Villages</u>						
Fairport Harbor	3,665	3,700	4,100	4,600	5,100	5,400
Grand River	613	800	1,100	1,400	1,700	1,800
Kirtland	5,530	7,200	9,500	11,700	13,700	15,000
Kirtland Hills	452	600	800	1,000	1,200	1,300
Lakeline	223	300	400	500	600	700
Madison	1,678	2,300	3,000	3,800	4,400	4,900
North Perry	851	1,200	1,600	2,000	2,300	2,500
Perry	917	1,300	1,700	2,100	2,500	2,700
Timberlake	964	1,300	1,800	2,200	2,600	2,900
Waite Hille	514	700	1,000	1,200	1,400	1,500
Willoughby Hills	5,247	7,000	9,400	11,700	13,800	15,100
<u>Townships</u>						
Concord	5,948	8,100	11,000	13,700	16,000	17,400
Leroy	1,759	2,400	3,200	4,000	4,700	5,100
Madison	12,455	16,900	22,900	28,600	33,400	36,500
Painesville	10,870	14,800	20,000	24,900	29,200	31,800
Perry	4,600	6,300	8,500	10,600	12,400	13,600
 <u>Lorain County</u>	 7,003	 7,500	 8,000	 8,300	 8,400	 8,200
<u>Townships</u>						
Columbia	5,738	6,100	6,600	6,800	6,900	6,700
Grafton	1,265	1,400	1,400	1,500	1,500	1,500

POPULATION DATA (Cont'd.)

	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>Medina County</u>	82,583	120,700	161,400	195,400	228,400	256,100
<u>Cities</u>						
Brunswick	15,852	30,000	38,000	42,000	48,000	56,000
Chippewa-on-the-Lake	341	500	600	800	900	1,000
Medina	10,828	15,800	21,700	27,600	32,600	36,400
Wadsworth	13,142	17,600	23,500	29,500	34,900	38,600
<u>Villages</u>						
Briarwood Beach	508	700	900	1,100	1,400	1,500
Gloria Glens	332	500	600	800	900	1,000
Leroy	715	1,000	1,300	1,700	2,000	2,200
Lodi	2,399	2,900	3,600	4,400	5,100	5,600
Seville	1,400	1,700	2,300	2,800	3,300	3,700
Spencer	758	1,000	1,400	1,800	2,100	2,300
<u>Townships</u>						
Brunswick Hills	2,293	3,200	4,100	5,000	5,900	6,500
Chatman	1,258	1,600	2,200	2,700	3,200	3,600
Granger	2,142	2,700	3,700	4,700	5,500	6,100
Guilford	2,028	2,600	3,500	4,400	5,200	5,700
Harrisville	1,122	1,400	1,900	2,400	2,900	3,200
Hinckley	4,210	5,300	7,300	9,200	10,900	12,000
Homer	845	1,100	1,500	1,800	2,200	2,400
Lafayette	2,465	3,100	4,300	5,400	6,300	7,000
Litchfield	1,332	1,700	2,300	2,900	3,400	3,800
Liverpool	2,826	4,200	6,900	7,800	8,600	9,200
Medina	2,445	4,000	5,300	6,400	7,500	9,000
Montville	2,497	4,000	5,400	6,400	7,400	8,400
Sharon	2,764	3,500	4,800	6,000	7,100	7,800
Spencer	728	900	1,300	1,600	1,900	2,100
Wadsworth	4,371	5,600	7,500	9,500	11,200	12,300
Westfield	1,253	1,600	2,200	2,700	3,200	3,500
York	1,729	2,500	3,300	4,000	4,800	5,200
<u>Portage County</u>	123,078	166,400	221,600	279,800	326,800	357,600
<u>Cities</u>						
Garrettsville	1,718	2,000	2,400	2,900	3,400	3,700
Kent	28,183	40,800	56,100	71,900	85,100	93,700
Ravenna	11,800	14,000	17,300	20,900	24,100	26,100
<u>Villages</u>						
Aurora	6,549	9,700	13,400	17,200	20,400	22,500
Brady Lake	450	600	800	1,000	1,200	1,300
Hiram	1,484	2,100	2,900	3,700	4,300	4,800

POPULATION DATA (Cont'd.)

<u>Portage County</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>Villages (Cont'd.)</u>						
Mantua	1,199	1,400	1,600	1,900	2,200	2,400
Mogadore (Part)	651	900	1,200	1,500	1,700	1,900
Streetsboro	7,966	10,000	13,100	16,500	19,300	21,200
Sugar Bush Knolls	119	200	200	300	300	300
Windham	3,360	3,100	3,300	3,600	3,900	4,100
<u>Townships</u>						
Atwater	2,408	3,300	4,400	5,600	6,500	7,100
Brimfield	6,721	9,200	12,300	15,500	18,200	19,800
Charlestown	864	1,200	1,600	2,000	2,300	2,600
Deerfield	2,175	3,000	4,000	5,000	5,900	6,400
Edinburg	1,563	2,100	2,900	3,600	4,200	4,600
Franklin	5,839	8,000	10,700	13,500	15,800	17,200
Freedom	1,649	2,300	3,000	3,800	4,500	4,900
Hiram	1,400	1,900	2,600	3,200	3,800	4,100
Mantua	1,199	1,600	2,200	2,800	3,200	3,500
Nelson	1,839	2,500	3,400	4,300	5,000	5,400
Palmyra	1,717	2,400	3,200	4,000	4,600	5,100
Paris	1,400	1,900	2,500	3,100	3,700	4,000
Randolph	4,150	5,700	7,600	9,600	11,200	12,200
Ravenna	8,836	12,100	16,200	20,400	23,900	26,100
Rootstown	6,010	8,200	11,000	13,900	16,200	17,700
Shalersville	4,967	6,800	9,100	11,500	13,400	14,700
Suffield	5,799	7,900	10,600	13,400	15,600	17,100
Windham	1,063	1,500	2,000	2,500	2,900	3,100
<u>Summit County</u>	552,498	640,800	737,700	814,900	860,300	875,300
<u>Cities</u>						
Akron	275,425	293,200	321,200	347,000	361,100	362,800
Barberton	33,052	36,200	40,100	43,600	45,500	45,800
Cuyahoga Falls	49,678	55,900	63,000	69,100	72,400	73,000
Munroe Falls	3,794	5,500	6,800	7,900	8,400	8,600
Norton	12,308	14,400	16,500	18,300	19,300	19,500
Stow	19,847	26,700	32,600	37,100	39,600	40,400
Tallmadge	15,274	19,800	23,900	27,000	28,800	29,200
<u>Villages</u>						
Boston Heights	846	1,000	1,100	1,200	1,300	1,300
Clinton	1,335	1,700	2,100	2,400	2,500	2,600
Fairlawn	6,102	8,600	10,700	12,300	13,100	13,400
Hudson	3,933	5,500	7,100	8,700	8,100	10,000
Lakemore	2,708	3,000	3,300	3,600	3,800	3,800
Macedonia	6,375	8,500	10,300	11,700	12,500	12,700
Mogadore (Part)	3,207	3,100	3,200	3,400	3,500	3,500
Northfield	3,870	4,100	4,500	5,000	5,600	6,200

POPULATION DATA (Cont'd.)

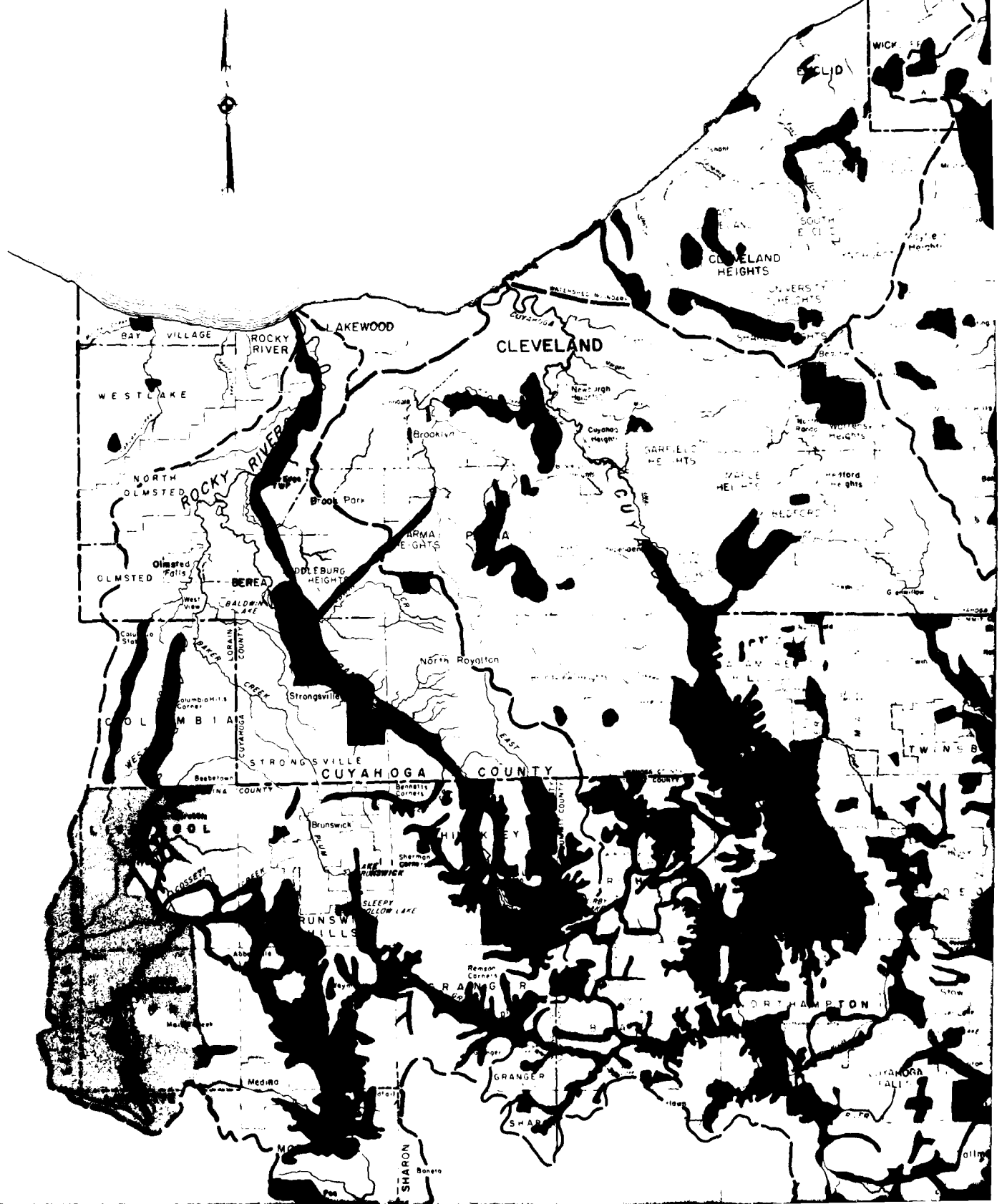
<u>Summit County</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>Villages (Cont'd.)</u>						
Peninsula	692	800	900	1,000	1,000	1,000
Richfield	3,228	6,000	9,000	9,500	10,200	11,000
Reminderville	215	4,000	6,000	8,000	10,000	10,000
Silver Lake	3,637	4,000	4,200	4,400	4,400	4,400
Twinsburg	6,432	8,600	10,400	11,900	12,700	12,900
<u>Townships</u>						
Bath	7,552	9,400	11,100	12,500	13,200	13,400
Boston	1,504	1,900	2,200	2,500	2,600	2,700
Copley	8,633	10,800	12,700	14,300	15,100	15,300
Coventry	13,429	16,800	19,800	22,200	23,500	23,700
Franklin	15,114	18,900	22,300	25,000	26,500	26,700
Green	13,473	16,800	19,900	22,300	23,600	23,800
Hudson	4,462	6,500	7,300	7,800	8,600	9,100
Northampton	5,662	7,100	8,400	9,400	10,000	10,100
Northfield Center	3,950	7,000	11,000	13,000	15,000	17,000
Richfield	1,715	2,000	3,000	4,500	5,200	7,000
Sagamore Hills	6,710	10,000	13,000	18,000	21,000	22,000
Springfield	16,921	21,200	25,000	28,000	29,600	29,900
Twinsburg	1,415	1,800	2,100	2,300	2,500	2,500

2. Land Use - A composite land use map has been prepared using the land use projections of the local planning agencies. Certain modifications have been made to reflect current land use policies and proposed changes. The history of land use planning in Northeast Ohio has not been one of widespread success. Too often land use and zoning policies have been changed to accommodate development with little or no thought being given to long term effects or aesthetics. Until such time as land use planning is made more effective, it will be subject to incidental changes and spot zoning, and can only be considered a desirable concept of long term development. Because of this uncertainty, the composite land use plan shown herein categorizes only industrial-commercial, residential, agricultural, open space and low density residential.

Figure A-2-1 shows the land use concept for the study area.

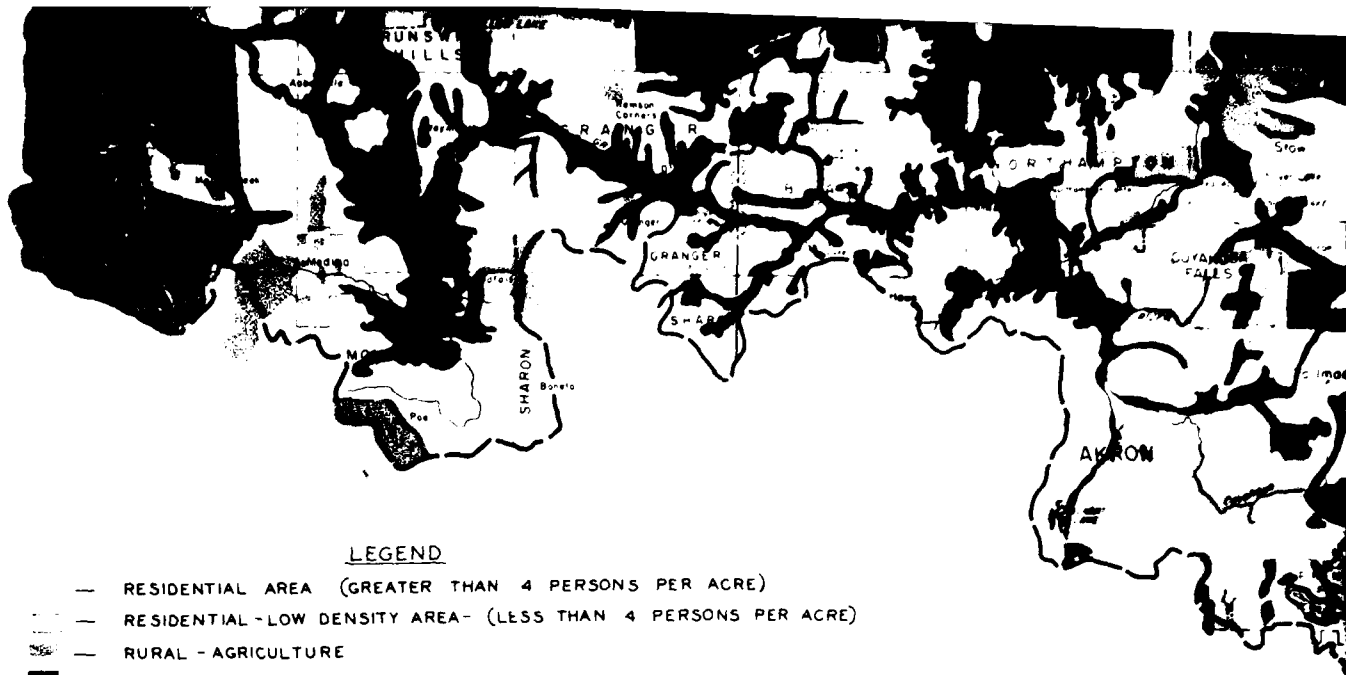
The plan shown is the land use concept for both 1990 and 2020, with the major difference being in the population densities. The residential areas would approach the upper limit of the density range as the end of the time frame approaches. Using the land use map and associated densities of population, the land use plan will accommodate the projected 2020 population.

# LAKE ERIE



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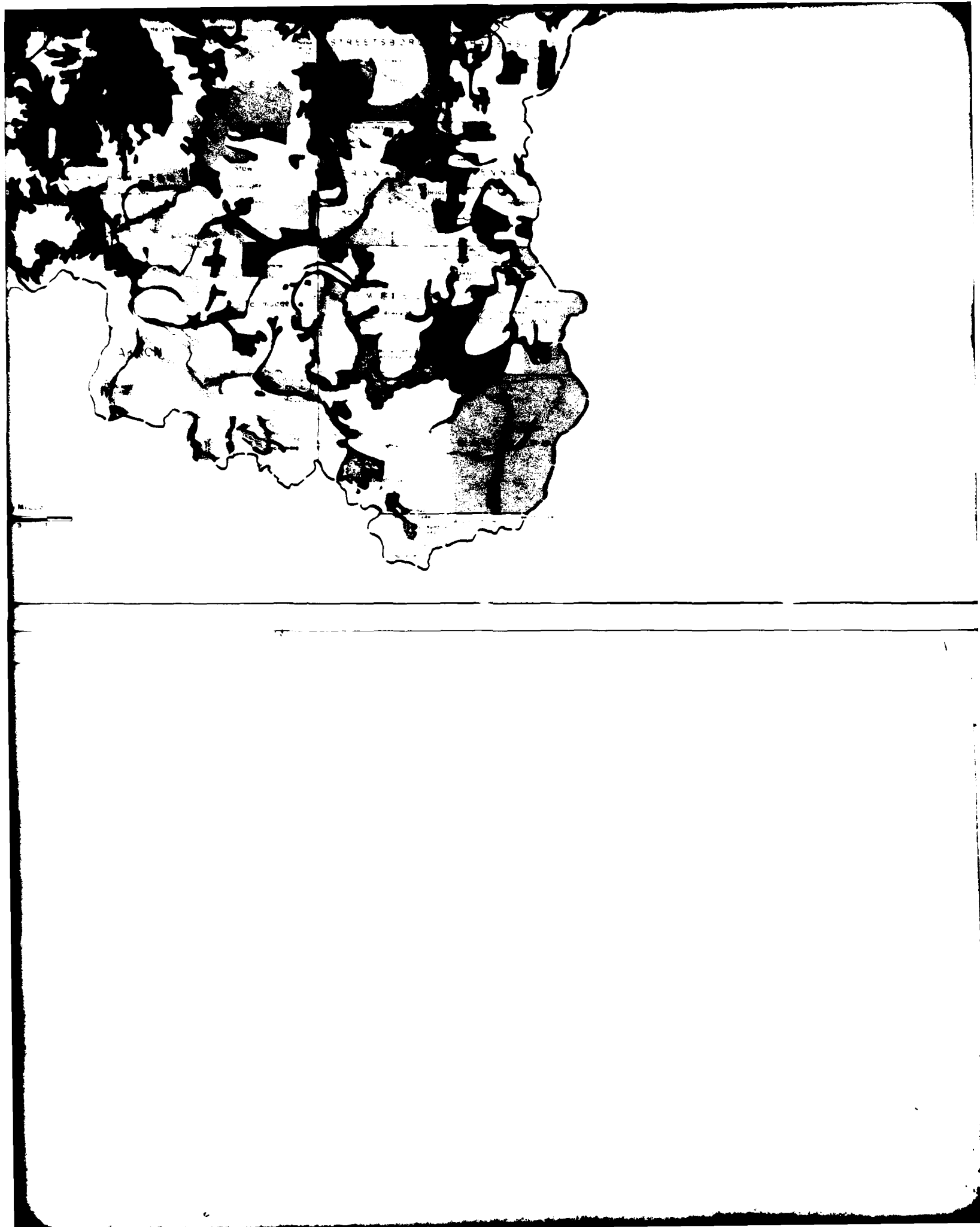




# LEGEND

- RESIDENTIAL AREA (GREATER THAN 4 PERSONS PER ACRE)
- RESIDENTIAL-LOW DENSITY AREA- (LESS THAN 4 PERSONS PER ACRE)
- RURAL - AGRICULTURE
- OPEN SPACE, RECREATION
- INDUSTRIAL & COMMERCIAL

SCALE OF MILES  
0 1 2 3 4



SURVEY SCOPE STUDY  
WASTE WATER MANAGEMENT PROGRAM  
CLEVELAND-AKRON METROPOLITAN  
AND  
THREE RIVERS WATERSHED AREAS

U. S. ARMY ENGINEER DISTRICT, BUFFALO

3. Existing Wastewater Treatment Plants - The existing publically owned and larger private plants, (larger than 20,000 gpd), have been tabulated and are shown on Table A-3-1. This tabulation is an updating of the one given in the Feasibility Report. For most plants, operating data for 1971 was available from the Ohio Department of Health. In cases where it was not, 1970 data was used. Operating data reported for most plants consist of BOD, suspended solids and flow. Several of the small plants do not collect any operating data. Some plants do not have meters to measure the flow. Many of the larger plants run additional analyses beyond the required BOD and suspended solids.

Treatment costs are included in the reports by some of the plants; however, they must be used cautiously since the methods of cost accounting for the plants are not uniform.

The design capacity and type of treatment provided has also been tabulated, along with current plans for either expansion or abandonment. When cost for these plans are available, they are also listed.

TABLE A-3-1  
OPERATING DATA AND WASTEWATER CHARACTERISTICS  
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BASIN

Municipality or Lower District	Wastewater Characteristics				Year	Treatment Efficiency		Hydraulic Loading Current Flow, mgd	Cost of Treatment \$/mg
	Suspended Solids, mg/l	5-Day BOD mg/l	Suspended Solids, mg/l	Effluent 5-Day BOD mg/l		S.S., %	BOD, %		
Cuyahoga County									
Bedford	149	246	9.9	24	1970	94%	90%	2.91	
Bedford Heights	214	138	125	67	1970	42%	51%	1.59	
Cleveland Easterly	131.8	126.7	39.8	25.8	1971	70%	80%	119.3	
Cleveland Southerly	298.3	200.4	29.5	17.5	1971	90%	91%	84.6	
Cleveland Westerly	196	472	140	170	1971	29%	64%	35.3	
Euclid	207	248	71	127	1971	66%	49%	16.20	
Maple Heights	188	165	9	19.3	1971	95%	88%	0.761	\$241.20
Solon - Central Area	296	324	154	67.2	1970	48%	79%	1.697	
S.D. #1 - Parma (Woodbury Hills)	263	317	25	40	1971	90.5%	87.4%	0.1337	
S.D. #2 - Shar-Bon (Seven Hills)	297	301	35	32	1971	88.2%	89.4%	0.054	
S.D. #3 - Richmond Heights (Scottish Highlands)	211	199	23	15	1971	89.1%	92.5%	0.082	
S.D. #13 - Broadview Heights (Bramblewood Subd.)	241	294	-5	53	1971	81.3%	82.0%	.0188	
S.D. #13 - Brecksville	195	201	16	18	1971	91.8%	91.0%	1.236	
S.D. #13 - Brecksville (South Estates)	322	322	16	30	1971	95.0%	90.7%	0.0331	
S.D. #13 - Walton Hills	369	230	135	63	1971	63.4%	72.6%	0.294	
Cloverleaf Hilltop, Inc.		143		9	1969		94%		
Pleasant Valley Shopping Center		No Data Available							
Seneca Club Apartments		No Data Available							
Geauga County									
Burton City Plant		No Data Available							
Broadwood Hills	254	345	34.6	29	1970	85%	92%		
Middlefield		No Data Available							
Middlefield Trailer Park		No Data Available							
Geauga Community Hospital		No Data Available							
Jacques Mobile Home Park		No Data Available							
Plymouth Acres - Claridon S.D. #1	45	86	11	10	1970	76%	88%		
Punderson State Park		No Data Available							

OPERATING DATA AND WASTEWATER CHARACTERISTICS  
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BASIN

Municipality or Sewer District	Law Suspended Solids, mg/l	Wastewater Characteristics			Year	Treatment Efficiency		Hydraulic Loading Current Flow, mgd	Cost of Treatment \$/mg
		5-Day BOD mg/l	Suspended Solids, mg/l	5-Day BOD mg/l		5.5% BOD%	BOD%		
Medina County									
Greager Lake Apartments									
No Data Available									
Portage County									
Aurora Plant #2 - Gauge Lake	178	149	16.2	13.5	1970	91%	91%	0.118	
Aurora Plant #3 - Four-Seasons Subd.	187	246	29	29	1970	84%	86%	0.120	
East	218	206	25	17	1971	89%	92%	2.830	
Marion	128	140	7	8.5	1971	95%	94%	0.214	\$108.00
Bavaria	194	136	14	15.9	1971	93%	86%	1.204	\$118.20
Aurora Acres S.D.	188	282	16	13.2	1971	91%	93%	.046	\$477.36
Brimfield S.D. #1 (Beechcrest)	117	141	8	2.5	1971	93%	96%	0.1886	\$228.65
Brimfield S.D. #3 (Holiday Inn)	114	128	10	3.4	1971	91%	97%	0.034	\$369.61
Field Local School District									
No Data Available									
Franklin S.D. #1	71	127	11	10.7	1971	84%	92%	.087	\$305.64
Franklin S.D. #3	102	246	13	6	1969	87%	97.5%		
Gillie Estates S.D.	203	256	8	3.9	1971	90%	98%	0.2404	\$383.59
East Rhodes Apartments									
No Data Available									
Randolph Trailer Park	54	222	5.4	3.2	1971	90%	99%		
Bavaria S.D. #1 - Lakeview Gardens	98	166	14	9.5	1971	86%	94%	0.0379	\$440.46
Bavaria S.D. #4 - Longfield	61	153	6	1.3	1971	90%	99%	.004	
Brookston S.D. #1 - Barwood	102	207	9	10.1	1971	91%	95%	0.0556	\$472.44
Shalerfield S.D. #1 - Red Fox	227	397	6	2.6	1971	97%	99%	0.043	\$891.93
Shalerfield S.D. #2 - Rolling Brook	204	277	11	8.1	1971	95%	97%	0.1043	\$289.27
Streetsboro S.D. #1 - Archwood	157	244	10	8.4	1969	93.6%	94.7%		
Streetsboro S.D. #3 - Rolling Hills	170	235	9	5.5	1971	95%	98%	0.0877	\$377.14
Valley Hills Trailer Park	120	232	12	7.1	1971	90%	97%	.247	\$411.00
Valley Lakes	116	149	11	4.2	1971	91%	98%	.003	\$489.39
Twins Lakes									
No Data Available									

OPERATING DATA AND WASTEWATER CHARACTERISTICS  
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BASIN

Municipality or Sewer District	Wastewater Characteristics				Year	Treatment Efficiency S.S. % BOD %	Hydraulic Loading Current Flow, mgd	Cost of Treatment \$/mg
	Raw Suspended Solids, mg/l	5-Day BOD mg/l	Suspended Solids, mg/l	Effluent 5-Day BOD mg/l				
<u>Summit County</u>								
Akron	244	152	41	25	1971	83%	75.99	\$ 64.66
Hudson (Village)	180	252	14	41	1970	87%	.591	
Northfield	178	231	41	39	1971	77%	.581	
Tallmadge	158	367	4	8	1969	97.5%		
Twinsburg	227	217	32	27	1970	86%	.765	
S.D. #1 - Roseland Estates	112	146	14	25.4	1971	87%	.091	
S.D. #5 - Hudson	133	149	11	6.9	1971	92%	.1589	
S.D. #6 - General Motors	154	164	73	54.5	1971	52%	.7891	
S.D. #7 - May Park Estates	108	207	4	5	1971	92%		
S.D. #9 - Macedonia Estates	185	185	24	26.3	1971	87%		
S.D. #14 - Rome Estate	173	182	9	3.7	1971	95%		
S.D. #15 - Northfield-Macedonia	166	150	12	14.7	1971	92.7%	1.199	
S.D. #17 - Com. Columns Apts.	108	222	17	13.2	1971	91%	.0648	
Greenwood of Sagamore Hills	123	165	23	21.6	1971	87.4%		
Northurden State Hospital		No Data Available						
Musical Arts Assoc. (Blossom Music Center)		No Data Available						
Union 21-Corps.		No Data Available						
Revere Local School District		No Data Available						
Stow-Kent Assoc.		No Data Available						
Stow-Kent #1	60	400	40	4.2	1971	78.5%		
Stow-Kent #2					1971	96.9%		

**OPERATING DATA AND WASTEWATER CHARACTERISTICS  
WASTEWATER TREATMENT PLANTS IN THE ROCKY RIVER BASIN**

Municipality or Sewer District	Law Suspended Solids, mg/l	Wastewater Characteristics			Year	Treatment Efficiency		Hydraulic Loading Current Flow, mgd	Cost of Treatment \$/mg
		5-Day BOD mg/l	Suspended Solids, mg/l	5-Day BOD mg/l		5.5% BOD%			
Carthage County									
Berene	207	200	18	18	1971	91%	91%	1.726	\$158.41
Brookpark	203	230	11.1	5.3	1971	95%	97%	0.784	
Lakewood	124	127	20	11	1971	84%	91%	16.70	\$ 55.89
North Olmsted	190	177	9	9	1970	94%	95%	3.68	
North Royalton - Area "A"	181	208	12	3	1971	93.5%	98.5%	0.228	
North Royalton - Area "B"	137	207	12	5	1971	91%	97.5%	0.301	
Strongsville - Area "A"	173	168	9	6	1971	95%	96%	0.797	
Strongsville - Area "B"	141	173	6.4	4	1971	95%	98%	0.177	
Strongsville - Area "C"	150	166	9	6	1971	94%	97%	0.092	
Strongsville - Rocky River	161	178	81	121.0	1971	49.6%	32.0%	7.097	
S.D. #8 - Middleburg Heights	175	148	17	9.9	1971	90.3%	93.3%	1.167	
S.D. #16 - Brentwood Estates	157	145	13.3	7.4	1971	91.5%	94.8%	0.0263	
Lakewood Country Club									
Olmsted Falls School District									
Madison County									
Madison	247	267	80	60	1971	67.6%	77.5%	1.47	
S.D. #7 - Colony Park	233	202	16	10.5	1971	93%	95%	.096	
S.D. #8 - Beverly Hills	154	130	16	10.6	1971	90%	92%		
S.D. #9 - Hockley Lake									
S.D. #11 - Village Homes									
S.D. #100 - Madison County	241	175	18	14	1971	93%	92%	.871	
S.D. #500 - Liverpool	266	137	27	8.3	1971	90%	94%	.488	

**OPERATING DATA AND WASTEWATER CHARACTERISTICS  
WASTEWATER TREATMENT PLANTS IN THE CHAGRIN RIVER BASIN**

Municipality or Sewer District	Wastewater Characteristics				Year	Treatment Efficiency S.S.% BOD%	Hydraulic Loading Current Flow, mgd	Cost of Treatment \$/mg
	Raw Suspended Solids, mg/l	5-Day BOD mg/l	Suspended Solids, mg/l	Effluent 5-Day BOD mg/l				
Cuyahoga County								
Chagrin Falls	134	176	16	13	1970	87%	0.810	
Pepper Pike - Creek Side	150	116	11	6	1971	92.7%	0.0645	
Pepper Pike - Pepper Hills	153	132	17	9	1971	88.9%	0.035	
Richory Hills - Mayfield Heights	368	263	46	20	1971	87.5%	0.0268	
Solon - W. & W.E. Area	135	130	6	8	1971	95.5%	0.228	\$527.60
Apple Hill Town House Corp. (Horseland Hills)	No Data Available							
Country Club, Inc.	No Data Available							
Woodburn Corp.	215	200	19	9	1969	89%		
Geauga County								
S.D. #2 - Chester Twp. (Willow Hills Estate)	265	266	13.7	13.7	1970	91%		
S.D. #1 - Bainbridge Twp. (Pilgrim Village Subd.)	219	278	56	50	1970	74%		
Chagrin River S.D.	71	138	10.9	4.4	1970	85%		
Russell Park	106	131	10.3	10.6	1970	90%		
Merhaven	153	190	40	27	1970	74%		\$528.46
Opalacka								
McFarland Creek S.D.	176	280	22	17	1970	88%		
South Russell	276	285	24	21	1970	91%		
Ravewood	91	171	23	20.6	1970	70%		
Tanglewood	No Data Available							
Knowles Indian Park	No Data Available							
Newbury Local School	No Data Available							
Silver Creek School District	No Data Available							
West Geauga Local School	No Data Available							
Belie Vernon Acres	80	95	6.6	3.4	1970	92%		
Wilder Mobile Home Park	No Data Available							
Scarsdale Estates	207	210	10.2	6.2	1970	93%		
Notre Dame Educ. Center	No Data Available							
Willoughby-Eastlake	167	130	73	92	1971	56%	4.28	\$ 69.88
Willoughby Mills (Dodd's Hill Subd.)	No Data Available							

OPERATING DATA AND WASTEWATER CHARACTERISTICS  
WASTEWATER TREATMENT PLANTS IN THE CHOCOMA RIVER BASIN

Municipality or Sector District	Wastewater Characteristics				Year	Treatment Efficiency		Hydraulic Loading Current Flow, mgd	Cost of Treatment \$/mg
	<u>Raw</u> Suspended Solids, mg/l	<u>5-Day BOD</u> mg/l	<u>Suspended</u> Solids, mg/l	<u>Effluent</u> 5-Day BOD mg/l		<u>5.5-6</u>	<u>BOD</u>		
<u>Fortalea County</u>									
Aurora (Plant #1)	110	155	19	12	1971	832	913	0.370	\$138.00
Robbiana Treiller Park	No Data Available								

4. Plant Value - Actual worth of the publicly owned plants and larger private plants was computed by the "reconstruction cost new less depreciation" method. Generally, reconstruction cost new was taken from generalized cost curves updated to 1972 price levels, except when the actual construction cost was recent and available. In some cases, such as the Cleveland plants, this cost had recently been computed and was simply up-dated for this study. Depreciation was taken at 2% per year for the larger facilities and 4-6% per year for the smaller plants. In some cases, the purchase price of small package plants was used, and actual worth was estimated, based on present condition. Actual worth as well as the reconstruction cost was reviewed with the County Sanitary Engineers.

Table A-4-1 tabulates the existing plant values and expansion plans.

In many cases, accurate figures for outstanding indebtedness are not available, since the auditors' debt figures often include debt on sewers, pumping stations and other facilities as well as treatment works. Where separated figures were known, they are shown in the tabulation.

TABLE A-1  
PLANT VALUES AND EXPANSION PLAN  
CUMBERLAND RIVER BASIN

Municipality or STATE DISTRICT	Type of FACILITY	Design Flow MGD	Expansion Plans	Reconstr. Cost, \$	Actual Cost, \$	Outstanding Debt, \$
<b>CUMBERLAND COUNTY</b>						
Bedford	S	2.2	Plans for expansion to 3.2 mgd are under consideration - estimated cost - \$1,100,000	\$ 2,210,000	\$ 1,270,000	\$
Bedford Heights	T	1.6		3,600,000	3,600,000	
Cleveland Eastern	S	172.0	To be expanded with tertiary to 300 mgd - 1970-1975 - estimated cost - \$37,000,000	99,653,551	53,316,312	
Cleveland Southern	S	96.0	To be expanded with tertiary - 1975-1977 - estimated cost - \$70,000,000	110,130,155	67,931,838	
Cleveland Western	P	30.0	To be expanded with tertiary to 50 mgd - 1970-1975 - estimated cost - \$33,000,000	19,267,142	8,143,030	
Duall	T	18.0	Secondary and tertiary to be added 1970-1975 - estimated cost - \$11,500,000	12,000,000	9,000,000	
Maple Heights	S	1.0	To be abandoned and tied into C.V.I.	1,180,000	800,000	
Solon - Central Area	S	2.4		2,400,000	1,735,000	
S.D. #1 - Parma (Woodbury Hills)	S	.12	To be abandoned and tied into L-W-1 Interceptor - 1975-1980	128,000	60,800	
S.D. #2 - Shar-Bow (Sharp Hills)	S	.05	To be abandoned and tied into Crossview Interceptor - 1975-1980	87,000	30,000	
S.D. #3 - Richmond Heights (Scottish Highlands)	S	.16	None	147,000	60,000	
S.D. #13 - Broadview Heights (Bramblewood Subd.)	S	.02	None	20,000	8,000	
S.D. #13 - Brecksville	S	1.0	To be abandoned and tied into C.V.I. - 1975-1980	1,180,000	600,000	
S.D. #13 - Brecksville (Southern Estates)	S	.3	To be abandoned and tied into C.V.I. - 1975-1980	69,000	20,000	
S.D. #13 - Walton Mills	S	.25	Holding tanks to be added	180,000	121,000	
Cloverleaf Millco, Inc.	S	.2	To be abandoned and tied into C.V.I.	40,000	10,000	
Pleasant Valley Shopping Center	S	.25	To be abandoned and connected to Keystone-Sprague Interceptor	45,000	12,000	
<b>COLUMBIA COUNTY</b>						
Burton City Plant	S	0.04	Expansion plants under design	94,000	24,000	
Broadwood Mills	S	0.25		66,000	22,000	
Middlefield	P	0.1	-1100 secondary lagoons	100,000	75,000	
Middlefield Trailer Park	S	.05		60,000	2,000	
Gaugus Community Hospital	S	0.13		69,000	23,000	
Jacques Mobile Home Park	S	0.025		64,000	21,000	

CUYAHOGA RIVER BASIN (Cont'd.)

Municipality or Sewer District	Type of Plant	Design Flow Mgd.	Expansion Plans	Reconstruct. Cost New	Actual Yrth.	Outstanding Debt
<u>Geauga County (Cont'd.)</u>						
Plymouth Acres, Cleaveland S.D. #1	S	0.012		\$ 22,000	\$ 10,000	\$
Punderson State Park	S	0.022	Expansion for park area - contracts awarded 1972	60,000	20,000	
<u>Madison County</u>						
Granger Lake Apartments	S	0.04		78,000	26,000	
<u>Portage County</u>						
Aurora Plant #2 - Geauga Lake	S	0.2	To be abandoned and tied into Aurora Westerly - 1972-1975	140,000	152,000	
Aurora Plant #3 - Four-Seasons Subd.	S	.12	To be abandoned and tied into Aurora Westerly - 1972-1975	130,000	117,000	
Kent	S	4.0		3,600,000	3,330,000	
Nantua	S	0.3		123,000	107,600	
Ravenna	S	1.15	Plant enlargement in cooperation with Portage County	1,300,000	650,000	
Aurora Acres S.D.	S	0.048	To be abandoned and tied into Aurora Westerly - 1972-1975	78,000	26,000	
Briarfield S.D. #1 (Beechcrest)	S	0.2	To be abandoned and tied into Fish Creek - 1973-1980	200,000	100,000	
Briarfield S.D. #3 (Hollyhock Inn)	S	0.205	To be abandoned and tied into Fish Creek - 1975-1980	83,000	56,000	12,000
Field Local School District	S	0.014		73,000	24,000	
Franklin S.D. #1 (Franklin Hills)	S	0.06	Expansion to 1.0 mgd under design - estimated cost - \$300,000	100,000	60,000	24,000
Franklin S.D. #3 (Dale Terrace)	S	0.034	To be abandoned and tied into Franklin Hills - 1973	82,000	8,000	
Gille Estates S.D.	S	0.14		530,000	300,000	90,000
Kent Rhodes Apartments	S	0.03		69,000	35,000	
Randolph Trailer Park	T	0.04		78,000	20,000	
Ravenna S.D. #1 Lakeview Gardens	S	0.01	To be abandoned and tied into Ravenna Plant - 1973-1975	57,000	18,000	
Ravenna S.D. #2 Longfield	S	0.1	To be abandoned and tied into Ravenna Plant - 1973-1975	70,000	50,000	
Rotatown S.D. #1 Berwynwood	S	0.06	To be abandoned and tied into Ravenna Plant - 1975-1980	106,000	35,000	
Shalersville S.D. #1 (Red Fox)	S	4		147,000	100,000	

CUMBERLAND RIVER BASIN (Cont'd.)						
Municipality or State District	Type of Plant	Design Flow (mgd)	Expansion Plans	Reconst. Cost, \$	Actual Cost, \$	Outstanding Debt
<b>Barren County (Cont'd.)</b>						
Shilohville S.D. #2 Bollingbrook	S	0.13		\$ 133,000	\$ 95,000	\$
Streetsboro S.D. #2 Arrowhead	S	0.064		94,000	75,000	
Streetsboro S.D. #3 Rolling Hills	S	0.12		180,000	100,000	56,000
Steady Lake	S	.036	To be abandoned and tied into Ravenscroft Plant - 1973-1977	120,000	100,000	70,000
Twin Lakes	T (Microst.)	.400		400,000	400,000	280,000
<b>Berlin County</b>						
Akron	S	87.5		39,000,000	31,200,000	
Baldon	S	0.55	Assess Lagoons under design, eventually to be tied into Macedonia	720,000	500,000	
Northfield	S	0.4		540,000	420,000	
Thilandage	S	0.15		142,000	71,000	
Thinsburg	S	0.6	Expansion with tertiary addition to 2.2 mgd - 1970-1975	770,000	578,000	
S.D. #1 Newland Estates	S	0.1	Connect to Thinsburg - 1975-1980	120,000	40,000	
S.D. #5 Madison	S	0.2	Discussion of expansion to 1.2 mgd 1974-1975 - estimated cost - \$1,000,000	160,000	120,000	
S.D. #6 General Motors	T	1.5		1,300,000	1,300,000	
S.D. #7 May Park Estates	S	0.03	To be tied into Cuyahoga Valley Interceptor	30,000	10,000	
S.D. #9 Macedonia	S	0.03		30,000	10,000	
S.D. #14 New Estates	S	0.1	To be abandoned and tied into Fish Creek - 1975	120,000	40,000	
S.D. #15 Northfield-Macedonia	S	1.0	Expansion with tertiary to 6.0 mgd	1,180,000	800,000	
S.D. #17 Conn. Colony Allot.	S	0.04		45,000	20,000	
Greenwood of Sagamore Hills	S	0.120		44,000	94,000	
Northwestern State Hospital	S	0.3	To be abandoned and connected to Cuyahoga Valley Interceptor 1975-1980	140,000	40,000	
Medical Arts Assoc. (Blossom Music Center)	S	0.09		112,000	112,000	
Ohio 21 - Corp.	S	0.06		94,000	40,000	
Stow-Bent Assoc.	S	0.03		10,000	20,000	
Edgert	S	0.02		20,000	14,000	

# ROCKY RIVER DAILY

San Francisco or San Francisco	Type of Plant	Design Flow (mgd)	Expansion Plans	Reconstruct. Cost - \$	Actual Worth	Outstanding Debt
<b>San Francisco</b>						
Area	S	3.0		\$ 2,650,000	\$ 2,650,000	\$
Brushport	S	1.0		600,000	600,000	
Lahman	S	13.0		9,300,000	8,403,000	
North Olmsted	T	9.0		8,000,000	7,000,000	
North Royalton - Area "A"	S	1.5	Sludge removed being studied	1,620,000	1,216,000	
North Royalton - Area "B"	S	1.0	Sludge removed being studied	1,180,000	883,000	
Strongsville - Area "A"	S	1.0	Either abandoned or temporarily enlarged	900,000	700,000	
Strongsville - Area "B"	S	0.25	To be expanded to 1.7 mgd plant with tertiary - 1970-1975 - estimated cost - \$1,000,000			
Strongsville - Area "C"	S	0.37	To be expanded with tertiary - 1970-1975	180,000	133,000	
S.D. 64 Rocky River	T	16.0	Secondary to be added 1970-1975, Contract awarded but in litigation estimated cost - \$3,500,000	320,000	230,000	
S.D. 68 Middleburg Heights	T	2.0	Expandable to 4.0 mgd with minor modifications	8,400,000		
S.D. 81A Brushwood Estates	S	0.16	To be abandoned and tied into Westlake Interceptor - 1975-1980	140,000	49,000	
Lahman Country Club	S	0.025	To be abandoned and tied into Westlake Interceptor - 1975-1980	64,000	21,000	
Olmsted Falls School District	S	0.03		69,000	23,000	
<b>Medina County</b>						
Medina	S	1.35	To be abandoned and tied into Medina- Liverpool Plant - 1970-1975	1,500,000	620,000	
S.D. 87 Colony Park	S	.13	To be abandoned and tied into Medina- Hickley Plant - 1970-1975	130,000	40,000	
S.D. 88 Beverly Hills	S	.13	Temporary expansion to 0.26 mgd until abandoned in 1975 - estimated cost - \$60,000	130,000	40,000	
S.D. 89 Hickley Lake	S	.010	To be abandoned and tied into new Hickley Regional Plant in 1980-1985	20,000	3,000	0
S.D. 911 Village Homes	S	0.012	To be abandoned and tied into Liverpool Plant - 1985-1990	24,000	3,000	0
S.D. 9100 Medina County	S	2.0	To be abandoned and tied into Liverpool Plant - 1975	2,000,000	1,000,000	900,000 (w/ interest)
S.D. 9500 Liverpool	S	1.5	To be enlarged and become regional plant	1,200,000	1,200,000	4,000,000 (w/ interest & include sewer)

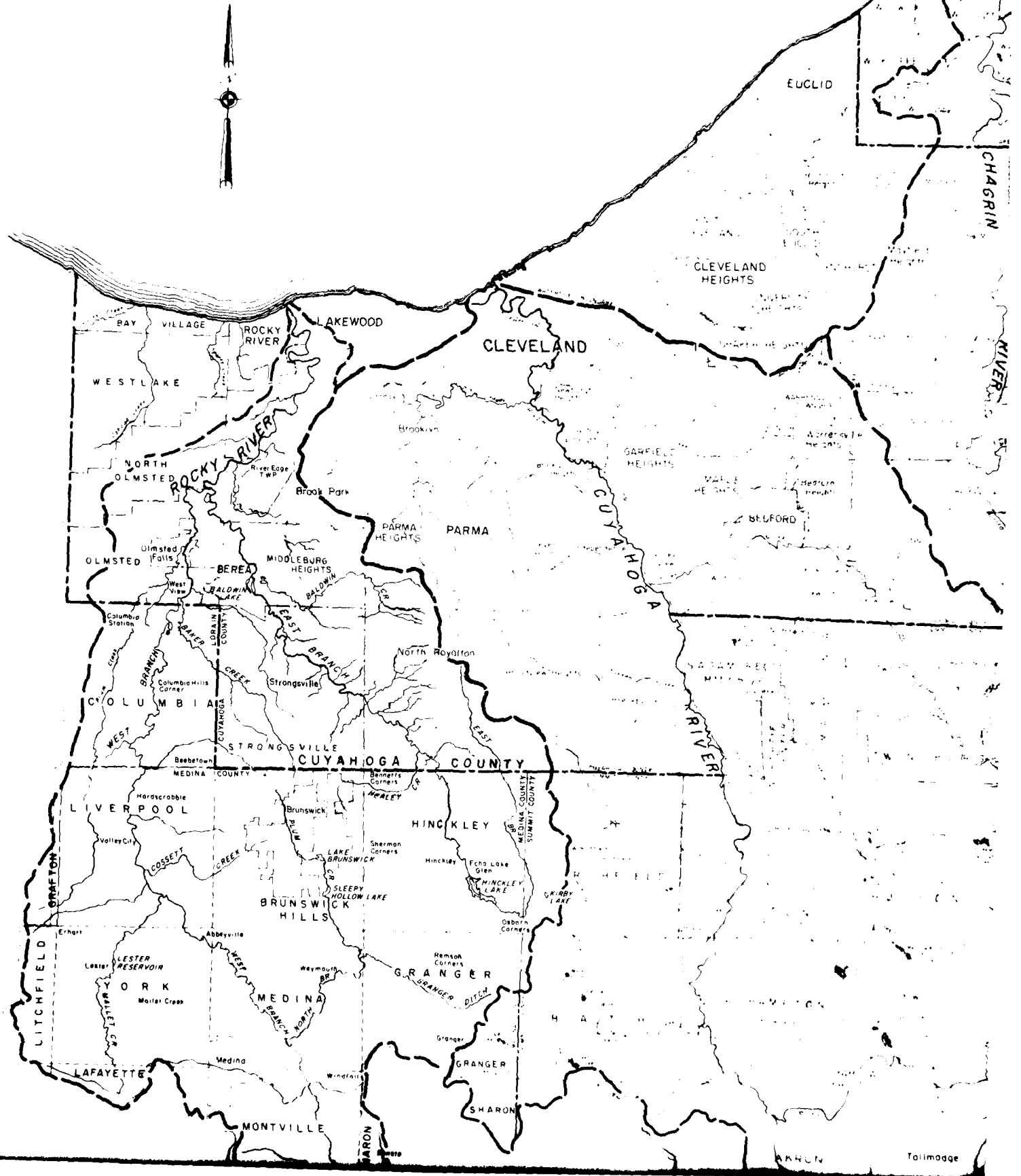
CHAGRIN RIVER BASIN

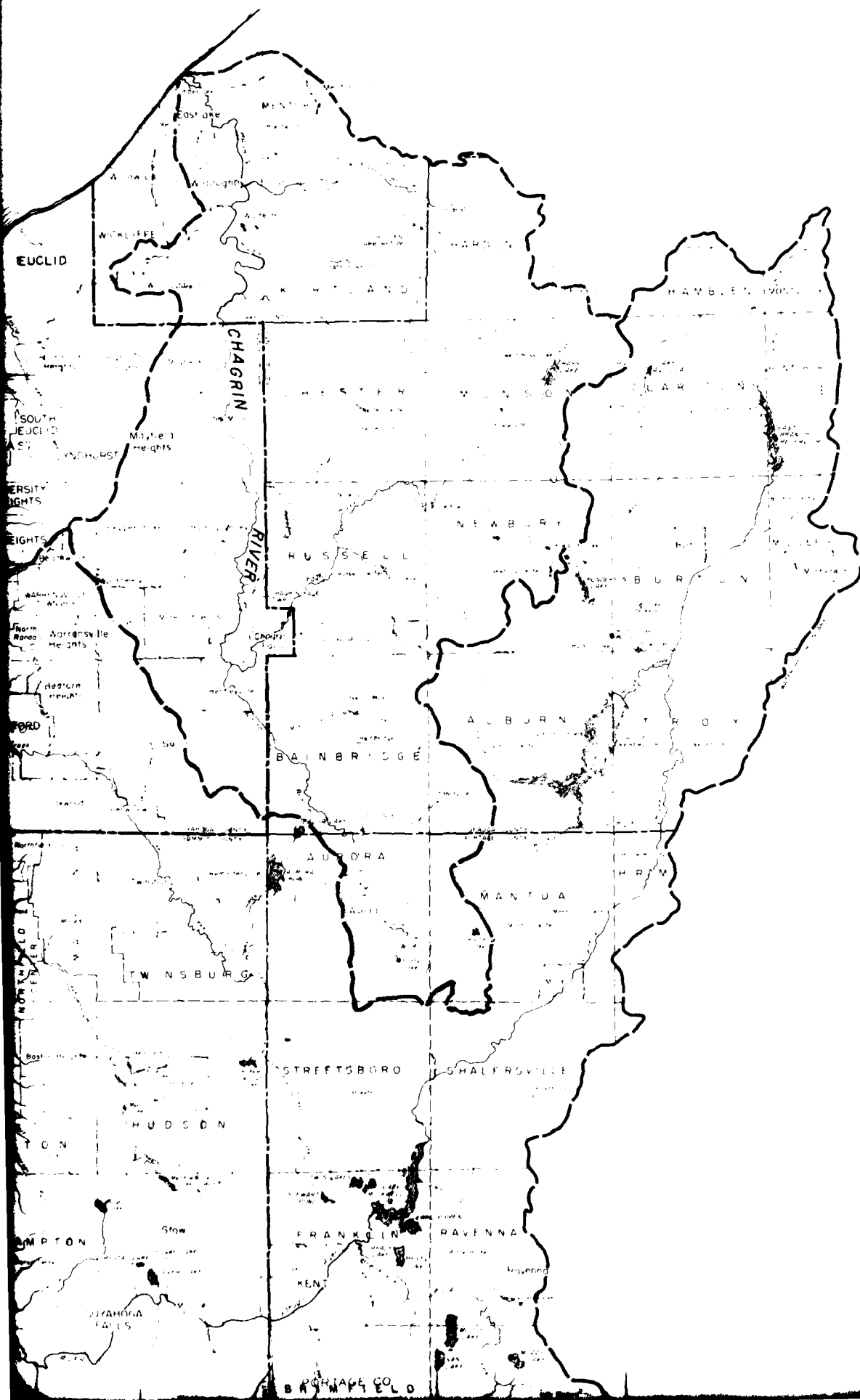
Municipality or Sewer District	Type of Plant	Design Flow (MGD)	Expansion Plans	Reconstr. Cost New	Actual Worth	Outstanding Debt
<u>Cuyahoga County</u>						
Chagrin Falls	S	0.4	Expansion with tertiary under design	\$ 220,000	\$ 165,000	\$
Pepper Pike - Creek Side	S	.12		87,000	29,000	
Pepper Pike - Pepper Hills	S	0.05		87,000	29,000	
Rickory Hills - Mayfield Heights	S	0.03		69,000	23,000	
Solon - W. & N.E. Area	S	0.78		960,000		
Apple Hill Town House Corp. (Norland Hills)	S	0.025		64,000	21,000	
Country Club Inc.	S	0.05		87,000	29,000	
Woodhewn Corp.	S	0.22		170,000		
<u>Geauga County</u>						
S.D. #2 Chester Twp. (Willow Hills Estates)	S	0.012		25,000	12,000	
S.D. #1 Bainbridge Twp. (Pilgrim Village Subd.)	S	0.025		50,000	20,000	
Chagrin River S.D.	S	0.02		60,000	20,000	
Russell Park	S	0.006		15,000	4,000	
Menhaven	T	0.08		108,000	85,000	45,000
Opelache						
McFarland Creek S.D.	S	0.09	to be abandoned and tied into	112,000	70,000	
South Russell	S	0.0125	McFarland Creek S.D. proposed	28,500	24,000	
Ravewood	T (lagoon)	0.120	Regional Plan	160,000	90,000	
Tanglewood	S	0.016		36,000	1,000	
Knobles Indus. Park						
McFarland Local School	S	0.03		69,000		
Silver Creek School District	S	0.01		42,000		
West Geauga Local School	S	0.06		94,000		
Belle Vernon Acres	S	0.04		78,000		
Wilder Mobile Home Park	S	0.03		69,000		
Scarsdale Estate	T	.027		50,000	25,000	
Motre Dam Educ. Center	S	0.04		78,000		
Willoughby-Eastlake	T	3.86		375,000	290,000	
Willoughby Hills (Dodd's Hill Subd.)	T	0.024				
<u>Portage County</u>						
Aucora (Plant #1)	P	0.04				
Rubine Trailer Park						

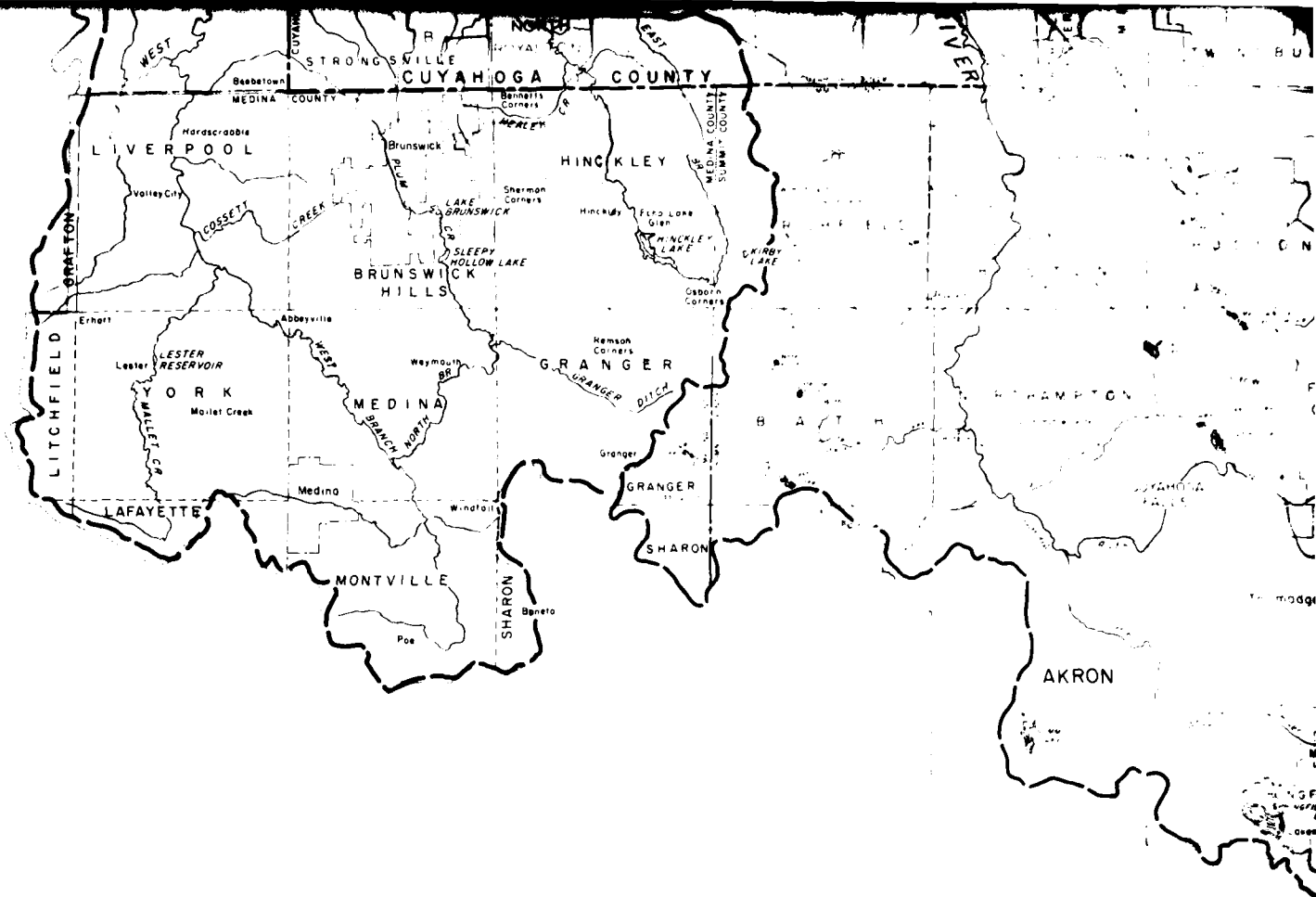
5. Subdistricts - The study area was divided into major sewerage districts that are expected to exist in 1980 or at the conclusion of improvement plans now underway. The population was calculated for each subdistrict and the population served by sewers was estimated. These subdistricts are shown on Figure A-5-1, and the populations served are tabulated on Table A-5-1.

Table A-5-2 shows the populations served by individual systems. Individual systems are septic tanks or small package plants.

In general, these subdistricts would become totally additive in the event of regional consolidation. Some of the 1980 area that is shown as served individually could become tributary to a sewerage district in the future. The tributary area of the subdistricts has been based on discussions with the various agencies dealing with the planning for the study area.

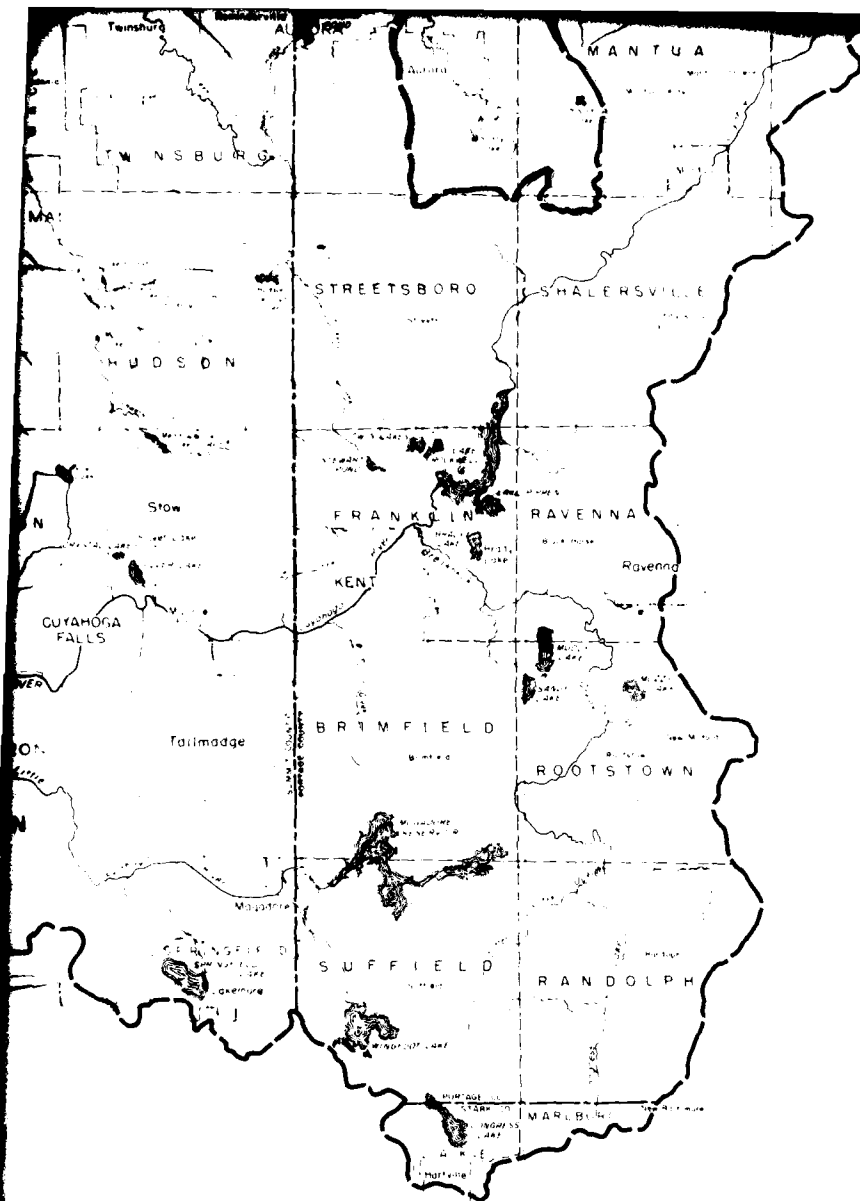






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**SURVEY SCOPE STUDY  
WASTEWATER MANAGEMENT PROGRAM  
CLEVELAND-AKRON METROPOLITAN  
AND  
THREE RIVERS WATERSHED AREAS**

**U. S. ARMY ENGINEER DISTRICT, BUFFALO**

15

A-26

TABLE A-5-1

A27

[illegible]

# CUYAHOGA RIVER WATERSHED

[illegible]

**CUYAHOGA RIVER WATERSHED (CONT'D)**

[illegible]

**CUYAHOGA RIVER WATERSHED (CONT'D)**

[illegible]

[illegible]

TABLE A-5-2  
AREAS OUTSIDE OF SEWERAGE DISTRICTS  
IN 1980 THAT ARE SERVED BY INDIVIDUAL SYSTEMS

	1970	1980	1990	2000	2010	2020
	Population	Population	Population	Population	Population	Population
3	10	126	10	140	10	150
	55	2,317	55	4,020	55	5,995
	40	856	40	1,080	40	2,200
	10	276	10	480	10	710
	96	7,250	96	10,655	96	12,680
	10	914	10	1,820	10	2,210
	25	988	25	2,750	25	3,750
	100	1,504	100	2,200	100	2,600
	10	85	10	110	10	130
	100	692	100	900	100	1,000
	40	2,265	40	3,360	40	4,000
	7	312	7	512	7	602
	4	792	4	1,304	4	1,582
	8	1,221	8	1,912	8	2,303
	1	2,754	1	3,212	1	3,611
	70	1,895	70	2,310	70	2,660
	18	3,045	18	4,500	18	5,330
	100	526	100	700	100	700
	70	2,100	70	2,150	70	3,710
	40	269	40	800	40	1,120
	40	950	40	1,480	40	1,760
	47	1,670	47	2,774	47	3,384
	60	3,143	60	5,640	60	8,285
	100	514	100	1,000	100	1,400
	7	558	7	917	7	1,351
	39	2,277	39	4,170	39	6,160
	83	1,966	83	3,984	83	6,310
	17	465	17	915	17	1,497
	15	1,054	15	2,118	15	3,558
	90	5,219	90	9,540	90	14,050

AREAS OUTSIDE OF SEWERAGE DISTRICTS  
IN 1980 THAT ARE SERVED BY INDIVIDUAL SYSTEMS

Area	1970 Population	1980 Population	1990 Population	2000 Population	2010 Population	2020 Population
Bandolph Township	40	2,490	60	4,556	60	6,720
Mariboro Township		75	100	125	130	175
Lake Township		100	125	150	175	200
Hartsville		50	75	100	125	150
Hiram Township	10	140	10	320	10	380
Marbury Township	100	4,038	100	10,600	100	12,900
Kirtland	100	5,530	100	11,700	100	13,700
Kirtland Hills	25	113	25	250	25	300
Chardon Township	60	1,910	60	4,980	60	6,120
Bambden Township	34	850	34	2,210	34	3,720
Montville Township	15	196	15	510	15	630
Chester Township	62	6,450	62	16,800	62	20,450
Russell Township	38	1,775	38	4,675	38	5,700
South Russell	7	187	7	645	7	798
Auburn Township	100	1,517	100	4,200	100	5,100
Troy Township	85	1,404	85	3,700	85	4,500
Clairidon Township	100	2,174	100	5,800	100	6,800
Mason Township	100	3,569	100	9,400	100	11,500
Buteburg Township	32	574	32	1,504	32	1,852
<b>GRAND TOTAL</b>		<b>81,095</b>		<b>176,918</b>		<b>224,160</b>

6. Wastewater Flows and Loads (Present and Future) - The development of reasonably accurate projected wastewater flows and loads is essential for the planning of future wastewater management programs, especially in consideration of municipal wastes, which account for the majority of wastewater flows.

The present per capita flow of municipal wastewater for separate and combined systems are found to be 110 to 156 gpcd, respectively, for the study area. These figures are based upon 1970 population data and on 1970 wastewater treatment plant records. Industrial flows have been deducted from the total plant flow in computing these figures, and are not included.

In projecting the future municipal waste flows, consideration was given to such factors as:

1. The present trend of increase in water consumption, per capita.
2. The increased use of water saving devices for the home.
3. The possible development of water reuse systems for the home.
4. Reduction in infiltration rates due to improved sewer construction techniques.
5. Replacement of certain existing combined sewers with separate sewers.

Present trends in water consumption for the study area show an increase in water consumption in the range of 1.0 to 1.3 gpcd per year. This per capita increase is due in part to the increased use of various modern facilities such as the automatic clothes washer, the automatic dishwasher, and garbage grinder, which use more water than previous methods. This trend is also due to the fact that there is an "abundance" of water in the study area. In this area the population in general does not feel a water supply shortage, and therefore does not generally make an attempt to conserve water.

Approximately 70% of total household water usage is for toilet flushing and bathing. <sup>(1)</sup> Flow reduction devices have been developed for these two

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<sup>(1)</sup> E.R. McLaughlin, "A Recycle System for Conservation of Water in Residences", ~~Water and Sewage~~ Works, April, 1968.

critical areas. Present toilets use 4 to 6 gallons per flush.<sup>(2)</sup> The newly developed reduced flush toilets use 2-1/2 gallons per flush. These are already in use in some foreign countries where water shortages exist. Dual flush toilets have also been developed, which use even smaller quantities of water when only urine is to be disposed of.

Present shower heads discharge between 5 and 10 gallons per minute. This flow can be reduced and still be acceptable. The reduced flush toilet and the limited flow shower head might provide a 30-50% reduction in domestic water usage. They are also economically feasible in that the capital costs are low and the yearly water savings and waste flow reduction is substantial.

The following household water reuse methods have been investigated:<sup>(2)</sup>

1. Reuse of all wastewaters, except for drinking.
2. Reuse of nonsanitary water for toilet water and laundering.
3. Aerobic treatment and reuse of all wastewaters for lawn watering.
4. Reuse of wash water for toilet flushing.

The only one of these which appears reasonably feasible in this area is the reuse of washwater for toilet flushing. It is doubtful however, that reuse technique will be developed to any significant extent in the study area. This is due to the relative abundance of water to handle future demands. In other areas of the country, where water shortages and water pollution from municipal wastes is a critical problem, these techniques will be more likely to be developed.

The resulting municipal wastewater flow projections are shown in Table A-6-1.

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<sup>(2)</sup>J. Bailey and H. Wallman, "Flow Reduction of Wastewater from Households", Water and Sewage Works, March, 1971.

TABLE A-6-1

MUNICIPAL WASTEWATER FLOWS

(gpcd - gallons per capita per day)

	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
Separate systems	110	120	125	130	140	150
Combined systems	156	160	164	168	172	175

The present and projected pollution loads from municipal wastewater treatment plants have also been estimated. The per capita generation rates for nitrogen and phosphorus were based upon monthly data from the Cleveland Easterly, Southerly, and Westerly Wastewater Treatment Plants.<sup>(3)</sup> Table A-6-2 shows the projected municipal wastewater pollution loads for the study area in pounds per capita per day.

TABLE A-6-2

MUNICIPAL WASTEWATER POLLUTION LOADS

(pounds per capita per day)

	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
BOD						
Separate System	.17	.18	.185	.19	.19	.195
Combined System	.15	.15	.16	.16	.17	.17
Suspended Solids						
Separate System	.18	.185	.19	.195	.195	.20
Combined System	.23	.23	.24	.24	.25	.25
Organic Nitrogen	.0146	.0146	.0146	.0146	.0146	.0146
Ammonia Nitrogen	.0097	.0097	.0097	.0097	.0097	.0097
Total Phosphorus as P	.0116	.0116	.0116	.0116	.0116	.0116
Sulfate	.0367	.0367	.0367	.0367	.0367	.0367
Chloride	.046	.046	.046	.046	.046	.046

<sup>(3)</sup> H & E, Ltd., "Feasibility Study for Wastewater Management Program", for Department of the Army, July, 1971.

A computer program was written to calculate and tabulate the present and future municipal wastewater flows and pollution loads based on the data in Tables A-6-1 and A-6-2. The program was run for each of the sewerage districts in the study area, based upon the population projections. This information is given in Table A-6-3. The total municipal wastewater flows and pollution loads for the Cuyahoga, Rocky and Chagrin River watersheds and for the direct discharges into Lake Erie are shown in Table A-6-4.

These tables do not include industrial flows or loads. The industrial loads were computed by AWARE and are presented in this phase report.

**TABLE A-6-3**  
**FLows AND LOADS IN INDIVIDUAL SEWERAGE DISTRICTS**  
**LAKE ERIE**

ROCKY RIVER	1970	1980	1990	2000	2010	2020
POPULATION	61537.	89340.	111900.	125805.	137700.	143930.
FLOW (MGD)	6.77	10.72	13.99	16.35	19.28	21.59
BOD (LBS/YR)	3818370.	5869637.	7556047.	8724576.	9549493.	10244220.
SUSPENDED SOLIDS (LBS/YR)	4042980.	6032682.	7760263.	8954170.	9800796.	10506890.
ORGANIC NITROGEN (LBS/YR)	327931.	476091.	596315.	670415.	733803.	767003.
AMMONIA NITROGEN (LBS/YR)	217872.	316308.	396182.	445412.	487527.	509584.
TOTAL PHOSPHORUS AS P (LBS/YR)	260548.	378265.	473784.	532658.	583022.	609379.
SULFATE (LBS/YR)	824319.	1170753.	1478955.	1685200.	1844560.	1928018.
CHLORIDE (LBS/YR)	1033206.	1500017.	1878800.	2112264.	2311982.	2416583.
NEW SEPARATE SEWER AREA						
WESTERLY	1970	1980	1990	2000	2010	2020
POPULATION	160000.	151000.	151000.	152000.	153000.	160000.
FLOW (MGD)	24.96	24.16	24.76	25.54	26.32	28.00
BOD (LBS/YR)	8759998.	8267248.	8818401.	8876501.	9493650.	9928000.
SUSPENDED SOLIDS (LBS/YR)	11432000.	12676450.	13227600.	13315200.	13961250.	14600000.
ORGANIC NITROGEN (LBS/YR)	852640.	804679.	804679.	810004.	815337.	852640.
AMMONIA NITROGEN (LBS/YR)	566483.	514615.	538615.	539100.	542496.	566480.
TOTAL PHOSPHORUS AS P (LBS/YR)	677440.	634314.	634314.	634314.	634314.	677440.
SULFATE (LBS/YR)	2183174.	2021777.	2021777.	2021777.	2021777.	2183174.
CHLORIDE (LBS/YR)	2746400.	2746400.	2746400.	2746400.	2746400.	2746400.
COMBINED SEWER AREA						
EASTERLY	1970	1980	1990	2000	2010	2020
POPULATION	44477.	50390.	50390.	50390.	50390.	50390.
FLOW (MGD)	7.14	7.14	7.14	7.14	7.14	7.14
BOD (LBS/YR)	44477.	2747419.	1079000.	1079000.	1079000.	1079000.
SUSPENDED SOLIDS (LBS/YR)	18177.	4127100.	1079000.	1079000.	1079000.	1079000.
ORGANIC NITROGEN (LBS/YR)	2424441.	2674151.	3073851.	3360110.	3514477.	3504206.
AMMONIA NITROGEN (LBS/YR)	1610074.	1776064.	2042216.	2232401.	2375625.	2375136.
TOTAL PHOSPHORUS AS P (LBS/YR)	1125474.	2124670.	2442237.	2664675.	2793118.	2784162.
SULFATE (LBS/YR)	6091804.	6722021.	7724777.	8446303.	8876844.	8808417.
CHLORIDE (LBS/YR)	7635503.	8425423.	9684740.	10586450.	11076160.	11040650.
COMBINED SEWER AREA						

TABLE A-6-3 (Cont'd.)

## LAKE ERIE

EUCLID	1970	1980	1990	2000	2010	2020
POPULATION	117,110.	142,618.	175,439.	204,550.	226,617.	237,030.
FLOW (MGD)	12.66	17.11	21.93	26.59	31.73	35.95
BOD (LBS/YR)	7142574.	9370001.	11846520.	14185540.	15715890.	16870610.
SUSPENDED SOLIDS (LBS/YR)	7562727.	9630279.	12166690.	14558840.	16129460.	17303180.
ORGANIC NITROGEN (LBS/YR)	613421.	760011.	934914.	1090047.	1207642.	1263137.
AMMONIA NITROGEN (LBS/YR)	407447.	504737.	621142.	724209.	802337.	839205.
TOTAL PHOSPHORUS AS P (LBS/YR)	487176.	603944.	732809.	866064.	959496.	1003584.
SULFATE (LBS/YR)	1541954.	1910438.	2350092.	2740049.	3035646.	3175135.
CHLORIDE (LBS/YR)	1937606.	2394555.	2945619.	3434393.	3804808.	3979731.
NEW SEPARATE SEWER AREA						

WILLOUGHBY-EAST LAKE	1970	1980	1990	2000	2010	2020
POPULATION	38374.	52190.	76900.	97300.	115200.	126800.
FLOW (MGD)	4.22	6.24	9.61	12.64	16.13	19.02
BOD (LBS/YR)	2178001.	3422170.	5142672.	6747753.	7989118.	9024988.
SUSPENDED SOLIDS (LBS/YR)	2517844.	418052.	5334011.	6625326.	8194358.	9566348.
ORGANIC NITROGEN (LBS/YR)	2082.8.	277641.	400400.	518513.	613901.	677717.
AMMONIA NITROGEN (LBS/YR)	135696.	194471.	272264.	344411.	407867.	448145.
TOTAL PHOSPHORUS AS P (LBS/YR)	172344.	240511.	325714.	411444.	487777.	527777.
SULFATE (LBS/YR)	54311.	77111.	10144.	126111.	151111.	176111.
CHLORIDE (LBS/YR)	64111.	87111.	11144.	136111.	161111.	186111.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

## ROCKY RIVER WATERSHED

MEDINA CO. S D 400	1970	1980	1990	2000	2010	2020
POPULATION	20885.	47783.	66143.	83212.	100983.	120508.
FLOW (MGD)	2.30	5.73	8.27	10.82	14.14	18.08
BOD (LBS/YR)	1296100.	3139342.	4466305.	5770751.	7003170.	8577156.
SUSPENDED SOLIDS (LBS/YR)	1372341.	3226545.	4587036.	5922612.	7187464.	8797083.
ORGANIC NITROGEN (LBS/YR)	111312.	254636.	352476.	443437.	538138.	642187.
AMMONIA NITROGEN (LBS/YR)	73954.	169176.	234179.	294612.	357530.	426458.
TOTAL PHOSPHORUS AS P (LBS/YR)	88440.	202313.	280049.	352319.	427562.	510231.
SULFATE (LBS/YR)	279805.	640077.	886018.	1114666.	1352717.	1614263.
CHLORIDE (LBS/YR)	350709.	802276.	1110540.	1397129.	1695503.	2023329.
NEW SEPARATE SEWER AREA						

MEDINA COUNTY S D	1970	1980	1990	2000	2010	2020
POPULATION	1825.	7616.	13785.	15812.	17585.	18840.
FLOW (MGD)	0.20	0.91	1.72	2.06	2.46	2.83
BOD (LBS/YR)	113241.	500371.	910832.	1096562.	1219519.	1340936.
SUSPENDED SOLIDS (LBS/YR)	119902.	514270.	955990.	1125419.	1251612.	1375319.
ORGANIC NITROGEN (LBS/YR)	4725.	40586.	73460.	84262.	93710.	100398.
AMMONIA NITROGEN (LBS/YR)	6461.	26764.	48906.	55982.	62260.	66703.
TOTAL PHOSPHORUS AS P (LBS/YR)	7777.	32241.	54366.	64449.	74455.	79768.
SULFATE (LBS/YR)	24447.	104010.	144657.	211819.	235560.	252471.
CHLORIDE (LBS/YR)	40642.	127473.	231450.	344411.	245252.	316111.
NEW SEPARATE SEWER AREA						

MO. ROYALTON A	1970	1980	1990	2000	2010	2020
POPULATION	2418.	3711.	5635.	6710.	10440.	13110.
FLOW (MGD)	1.27	3.13	4.00	4.27	4.84	5.55
BOD (LBS/YR)	154142.	331471.	534811.	675411.	717772.	736641.
SUSPENDED SOLIDS (LBS/YR)	163111.	340641.	511001.	640641.	711111.	755500.
ORGANIC NITROGEN (LBS/YR)	13237.	27045.	40282.	52011.	55155.	55155.
AMMONIA NITROGEN (LBS/YR)	8795.	17968.	30744.	38555.	36644.	36644.
TOTAL PHOSPHORUS AS P (LBS/YR)	10517.	21418.	36772.	41124.	43822.	43822.
SULFATE (LBS/YR)	13274.	67982.	116340.	130740.	138643.	138643.
CHLORIDE (LBS/YR)	41706.	85207.	145821.	163870.	173776.	173776.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

ROCKY RIVER WATERSHED

STRONGSVILLE B	1970	1980	1990	2000	2010	2020
POPULATION	1500.	3465.	4300.	4980.	5200.	5240.
FLOW (MGD)	0.16	0.42	0.54	0.63	0.73	0.79
BOD (LBS/YR)	13075.	227650.	290357.	338428.	360620.	372957.
SUSPENDED SOLIDS (LBS/YR)	98550.	233974.	299205.	347334.	370110.	382520.
ORGANIC NITROGEN (LBS/YR)	7993.	18465.	22915.	26006.	27711.	27924.
AMMONIA NITROGEN (LBS/YR)	5311.	12268.	15224.	17274.	18411.	18552.
TOTAL PHOSPHORUS AS P (LBS/YR)	6351.	14671.	18206.	20662.	22017.	22186.
SULFATE (LBS/YR)	20093.	46415.	57601.	65370.	69657.	70192.
CHLORIDE (LBS/YR)	25189.	53177.	72197.	81215.	87308.	87780.
NEW SEPARATE SEWER AREA						

NO ROYALTOWN B	1970	1980	1990	2000	2010	2020
POPULATION	2948.	3704.	4449.	4911.	5290.	5290.
FLOW (MGD)	0.32	0.44	0.56	0.65	0.74	0.79
BOD (LBS/YR)	182923.	243353.	300417.	346126.	368661.	376516.
SUSPENDED SOLIDS (LBS/YR)	193193.	250113.	308538.	355234.	376516.	386170.
ORGANIC NITROGEN (LBS/YR)	15710.	19739.	23709.	26547.	28110.	28170.
AMMONIA NITROGEN (LBS/YR)	10437.	13114.	15762.	17671.	18729.	18729.
TOTAL PHOSPHORUS AS P (LBS/YR)	12482.	15632.	18437.	21132.	22394.	22398.
SULFATE (LBS/YR)	13473.	40617.	49547.	55407.	70861.	70862.
CHLORIDE (LBS/YR)	43407.	62117.	78632.	91213.	44311.	44311.
NEW SEPARATE SEWER AREA						

STRONGSVILLE C	1970	1980	1990	2000	2010	2020
POPULATION	1111.	1711.	2711.	4411.	5111.	4120.
FLOW (MGD)	0.11	0.17	0.27	0.44	0.51	0.41
BOD (LBS/YR)	744.	1211.	1711.	2711.	3111.	3111.
SUSPENDED SOLIDS (LBS/YR)	744.	1211.	1711.	2711.	3111.	3111.
ORGANIC NITROGEN (LBS/YR)	1111.	1711.	2711.	4411.	5111.	4120.
AMMONIA NITROGEN (LBS/YR)	1111.	1711.	2711.	4411.	5111.	4120.
TOTAL PHOSPHORUS AS P (LBS/YR)	1111.	1711.	2711.	4411.	5111.	4120.
SULFATE (LBS/YR)	1111.	1711.	2711.	4411.	5111.	4120.
CHLORIDE (LBS/YR)	1111.	1711.	2711.	4411.	5111.	4120.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

## ROCKY RIVER WATERSHED

DEBRA	1970	1980	1990	2000	2010	2020
POPULATION	22300.	27600.	33000.	36900.	39100.	39100.
FLOW (MGD)	2.46	3.31	4.12	4.80	5.47	5.86
BOD (LBS/YR)	1387671.	1813320.	2228325.	2559011.	2711583.	2782941.
SUSPENDED SOLIDS (LBS/YR)	1471417.	1863690.	2288548.	2626356.	2782941.	2854298.
ORGANIC NITROGEN (LBS/YR)	119348.	147080.	175857.	196640.	208364.	208364.
AMMONIA NITROGEN (LBS/YR)	79293.	97718.	116836.	130644.	138433.	138433.
TOTAL PHOSPHORUS AS P (LBS/YR)	94825.	116858.	137722.	156234.	165549.	165549.
SULFATE (LBS/YR)	300006.	369716.	442051.	494294.	523764.	523764.
CHLORIDE (LBS/YR)	376029.	463404.	554070.	619551.	656489.	656489.
NEW SEPARATE SEWER AREA						

NO. OLIVESTED	1970	1980	1990	2000	2010	2020
POPULATION	45361.	70666.	91390.	107060.	114498.	115793.
FLOW (MGD)	4.99	8.48	11.42	13.92	16.03	17.37
BOD (LBS/YR)	2814649.	4642755.	6171109.	7424610.	7940435.	8241565.
SUSPENDED SOLIDS (LBS/YR)	2980216.	4771720.	6337895.	7619995.	8149393.	8452888.
ORGANIC NITROGEN (LBS/YR)	241729.	376579.	487017.	570523.	610160.	617061.
AMMONIA NITROGEN (LBS/YR)	160601.	250193.	323566.	379046.	405380.	409965.
TOTAL PHOSPHORUS AS P (LBS/YR)	192058.	270200.	380945.	453702.	484784.	484784.
SULFATE (LBS/YR)	607134.	944600.	1224114.	1434124.	1531757.	1531757.
CHLORIDE (LBS/YR)	761411.	1106440.	1433337.	1747530.	1922420.	1944164.
NEW SEPARATE SEWER AREA						

MIDDLEBURG HTS.	1970	1980	1990	2000	2010	2020
POPULATION	12307.	16500.	20300.	24100.	24500.	24500.
FLOW (MGD)	1.46	1.98	2.54	3.09	3.43	3.69
BOD (LBS/YR)	714771.	1014000.	1370757.	1595084.	1679073.	1750035.
SUSPENDED SOLIDS (LBS/YR)	812111.	1114102.	1407804.	1637073.	1743786.	1799748.
ORGANIC NITROGEN (LBS/YR)	65904.	97228.	108174.	122567.	130560.	133023.
AMMONIA NITROGEN (LBS/YR)	43785.	58418.	71872.	81431.	86742.	87096.
TOTAL PHOSPHORUS AS P (LBS/YR)	52302.	61861.	85950.	97342.	103733.	104156.
SULFATE (LBS/YR)	165662.	221026.	271929.	309076.	328170.	329529.
CHLORIDE (LBS/YR)	207642.	277034.	343837.	386170.	411355.	413034.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

ROCKY RIVER WATERSHED

<u>BROOK PARK</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
POPULATION	16400.	23700.	29800.	43200.	36500.	36800.
FLOW (MGD)	1.00	2.84	3.72	5.62	5.11	5.52
UOD (LBS/YR)	1017620.	1557090.	2012245.	2975918.	2531273.	2619238.
SUSPENDED SOLIDS (LBS/YR)	1077480.	1600342.	2066628.	3074754.	2597886.	2686398.
ORGANIC NITROGEN (LBS/YR)	87310.	120297.	158904.	230213.	194508.	196107.
AMMONIA NITROGEN (LBS/YR)	53064.	83310.	105507.	152449.	129228.	130790.
TOTAL PHOSPHORUS AS P (LBS/YR)	69438.	100340.	126173.	182909.	154541.	155811.
SULFATE (LBS/YR)	219680.	317473.	339186.	578686.	488936.	492954.
CHLORIDE (LBS/YR)	275356.	347423.	500347.	725328.	612835.	617872.
NEW SEPARATE SEWER AREA						

<u>LAKEWOOD</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
POPULATION	180632.	91860.	105464.	116240.	123082.	124784.
FLOW (MGD)	8.87	11.02	13.18	15.11	17.23	18.72
UOD (LBS/YR)	5003214.	6035200.	7121456.	8061243.	8535736.	8881500.
SUSPENDED SOLIDS (LBS/YR)	5297521.	6202845.	7313927.	8273380.	8760300.	9104230.
ORGANIC NITROGEN (LBS/YR)	424688.	484522.	562018.	612443.	655904.	664974.
AMMONIA NITROGEN (LBS/YR)	285478.	325230.	373325.	411438.	435772.	441798.
TOTAL PHOSPHORUS AS P (LBS/YR)	341330.	398335.	445534.	492100.	511120.	518331.
SULFATE (LBS/YR)	1990105.	1230517.	1412742.	1577332.	1541743.	1571441.
CHLORIDE (LBS/YR)	1394511.	1540329.	1770740.	1901000.	1905545.	1951100.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

CHAGRIN RIVER WATERSHED

FAIRMOUNT RD	1970	1980	1990	2000	2010	2020
POPULATION	628.	4485.	12430.	16450.	20030.	22680.
FLOW (MGD)	0.07	0.54	1.55	2.14	2.80	3.40
BOD (LBS/YR)	38967.	294664.	839336.	1140807.	1389080.	1614240.
SUSPENDED SOLIDS (LBS/YR)	41260.	302850.	862020.	1170828.	1425635.	1655638.
ORGANIC NITROGEN (LBS/YR)	3347.	23901.	66239.	87662.	106740.	120862.
AMMONIA NITROGEN (LBS/YR)	2223.	15879.	44008.	58241.	70916.	80298.
TOTAL PHOSPHORUS AS P (LBS/YR)	2659.	18989.	52629.	69649.	84807.	96027.
SULFATE (LBS/YR)	8412.	60079.	166506.	220356.	268312.	303810.
CHLORIDE (LBS/YR)	10544.	75303.	208700.	276195.	336304.	380797.
NEW SEPARATE SEWER AREA						

CHAGRIN FALLS	1970	1980	1990	2000	2010	2020
POPULATION	4606.	6720.	9507.	11238.	12204.	12666.
FLOW (MGD)	0.51	0.81	1.19	1.46	1.71	1.90
BOD (LBS/YR)	285802.	441504.	641960.	779355.	846347.	901502.
SUSPENDED SOLIDS (LBS/YR)	302614.	453768.	659310.	791865.	868620.	924618.
ORGANIC NITROGEN (LBS/YR)	24545.	35811.	50663.	59887.	65035.	67497.
AMMONIA NITROGEN (LBS/YR)	16308.	23792.	33660.	39788.	43208.	44844.
TOTAL PHOSPHORUS AS P (LBS/YR)	13502.	28452.	40253.	47582.	51072.	51628.
SULFATE (LBS/YR)	61700.	90018.	127351.	150539.	163479.	169667.
CHLORIDE (LBS/YR)	77339.	112829.	150622.	188684.	204405.	212662.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

CHAGRIN RIVER WATERSHED

AURORA CENTRAL	1970	1980	1990	2000	2010	2020
POPULATION	10900.	11300.	6549.	11000.	14020.	16285.
FLOW (MGD)	0.22	0.18	0.82	1.51	1.96	2.44
BOD (LBS/YR)	123479.	206035.	442221.	804460.	972287.	1159084.
SUSPENDED SOLIDS (LBS/YR)	130743.	211758.	454173.	825630.	997873.	1188804.
ORGANIC NITROGEN (LBS/YR)	10605.	10712.	34700.	61816.	74713.	86783.
AMMONIA NITROGEN (LBS/YR)	7046.	11103.	23187.	41070.	49638.	57657.
TOTAL PHOSPHORUS AS P (LBS/YR)	8426.	13278.	27728.	49114.	59361.	68451.
SULFATE (LBS/YR)	26657.	40008.	87727.	155388.	187805.	218146.
CHLORIDE (LBS/YR)	33412.	52657.	109258.	194764.	235326.	273425.
NEW SEPARATE SEWER AREA						
MCFARLAND CREEK	1970	1980	1990	2000	2010	2020
POPULATION	1635.	5227.	15206.	20426.	25120.	28630.
FLOW (MGD)	0.18	0.63	1.90	2.66	3.52	4.29
BOD (LBS/YR)	101452.	343414.	1026785.	1410543.	1742070.	2037739.
SUSPENDED SOLIDS (LBS/YR)	107419.	352953.	1054536.	1451920.	1787215.	2089988.
ORGANIC NITROGEN (LBS/YR)	8713.	27855.	81033.	108850.	133864.	152569.
AMMONIA NITROGEN (LBS/YR)	5789.	18506.	53817.	72318.	88337.	101364.
TOTAL PHOSPHORUS AS P (LBS/YR)	6423.	22131.	64382.	96444.	126444.	147114.
SULFATE (LBS/YR)	21402.	70214.	233632.	273016.	336400.	384114.
CHLORIDE (LBS/YR)	2745.	47761.	200309.	342000.	401000.	490000.
NEW SEPARATE SEWER AREA						
SOLOM NORTHEAST	1970	1980	1990	2000	2010	2020
POPULATION	1400.	1100.	5000.	5000.	9000.	10000.
FLOW (MGD)	0.1	0.14	0.71	0.9	1.22	1.50
BOD (LBS/YR)	9400.	20000.	778100.	470000.	600410.	711700.
SUSPENDED SOLIDS (LBS/YR)	45000.	210700.	490000.	401107.	610000.	740000.
ORGANIC NITROGEN (LBS/YR)	7100.	16780.	29842.	36770.	46824.	53200.
AMMONIA NITROGEN (LBS/YR)	4780.	11153.	10827.	24429.	30448.	35405.
TOTAL PHOSPHORUS AS P (LBS/YR)	5716.	13337.	23710.	29214.	36412.	42340.
SULFATE (LBS/YR)	18084.	42196.	75015.	92429.	115201.	133055.
CHLORIDE (LBS/YR)	22660.	52888.	34024.	115851.	144394.	167900.
NEW SEPARATE SEWER AREA						

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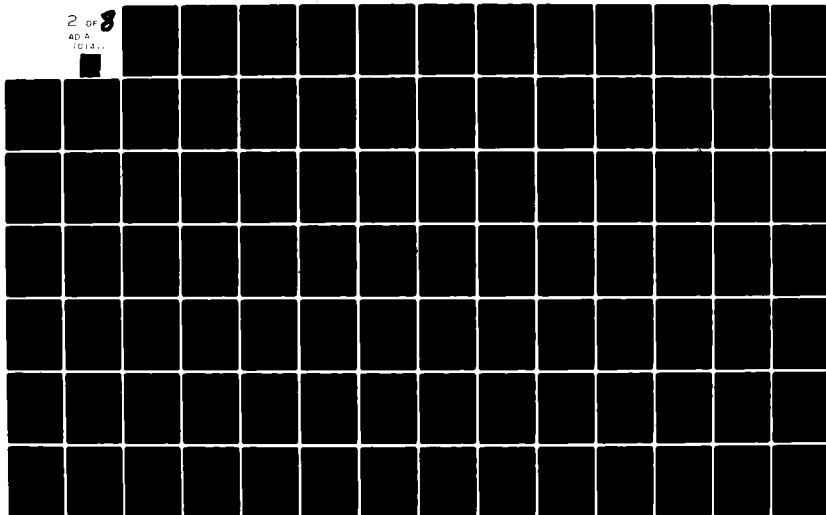


TABLE A-6-3 (Cont'd.)

## CUYAHOGA RIVER WATERSHED

MIDDLEFIELD	1970	1980	1990	2000	2010	2020
POPULATION	1700.	1000.	8700.	5200.	7000.	8200.
FLOW (MGD)	0.19	0.36	0.59	0.68	0.98	1.23
BOD (LBS/YR)	105485.	197170.	317367.	360620.	485450.	583635.
SUSPENDED SOLIDS (LBS/YR)	111670.	207575.	325945.	370110.	498225.	598600.
ORGANIC NITROGEN (LBS/YR)	9059.	15987.	25046.	27711.	37309.	43698.
AMMONIA NITROGEN (LBS/YR)	6019.	10621.	16640.	18411.	24783.	29032.
TOTAL PHOSPHORUS AS P (LBS/YR)	7198.	12702.	19300.	22017.	29638.	34719.
SULFATE (LBS/YR)	22777.	40146.	62759.	67657.	93768.	109843.
CHLORIDE (LBS/YR)	28543.	50370.	78913.	87308.	117530.	137678.
NEW SEPARATE SEWER AREA						

BURTON	1970	1980	1990	2000	2010	2020
POPULATION	1100.	2100.	2900.	3500.	4200.	5100.
FLOW (MGD)	0.12	0.25	0.36	0.45	0.59	0.76
BOD (LBS/YR)	68255.	137770.	195822.	242725.	291270.	362992.
SUSPENDED SOLIDS (LBS/YR)	72270.	141802.	201115.	249112.	298935.	372300.
ORGANIC NITROGEN (LBS/YR)	5862.	11191.	15454.	18651.	22382.	27178.
AMMONIA NITROGEN (LBS/YR)	3895.	7435.	10267.	12392.	14870.	18057.
TOTAL PHOSPHORUS AS P (LBS/YR)	4657.	8891.	12279.	14819.	17783.	21593.
SULFATE (LBS/YR)	14735.	28111.	38847.	46984.	56261.	68317.
CHLORIDE (LBS/YR)	18409.	35254.	48671.	58764.	70518.	85624.
NEW SEPARATE SEWER AREA						

MANTUA	1970	1980	1990	2000	2010	2020
POPULATION	1440.	1850.	2330.	2740.	3050.	3775.
FLOW (MGD)	0.16	0.22	0.30	0.38	0.51	0.60
BOD (LBS/YR)	89150.	121545.	160709.	203884.	251047.	282220.
SUSPENDED SOLIDS (LBS/YR)	98403.	129221.	165051.	209254.	257653.	290175.
ORGANIC NITROGEN (LBS/YR)	7674.	9857.	12697.	15667.	19291.	21183.
AMMONIA NITROGEN (LBS/YR)	5078.	6550.	8426.	10409.	12817.	14073.
TOTAL PHOSPHORUS AS P (LBS/YR)	6077.	7833.	10077.	12448.	15327.	16830.
SULFATE (LBS/YR)	19290.	24782.	31881.	39383.	48492.	53247.
CHLORIDE (LBS/YR)	24178.	31061.	39960.	49363.	60780.	66740.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

## CUYAHOGA RIVER WATERSHED

SHALERSVILLE	1970	1980	1990	2000	2010	2020
POPULATION	2782.	8090.	5464.	6900.	8040.	8830.
FLOW (MGD)	0.33	0.49	0.68	0.70	1.13	1.32
UOD (LBS/YR)	185031.	268056.	368756.	478515.	557574.	628475.
SUSPENDED SOLIDS (LBS/YR)	195317.	275502.	378028.	491107.	572247.	644590.
ORGANIC NITROGEN (LBS/YR)	15891.	21742.	29118.	36770.	42845.	47055.
AMMONIA NITROGEN (LBS/YR)	10558.	14445.	19345.	24429.	28466.	31263.
TOTAL PHOSPHORUS AS P (LBS/YR)	12626.	17275.	23135.	27245.	34041.	37380.
SULFATE (LBS/YR)	39945.	54654.	73193.	92409.	107700.	118282.
CHLORIDE (LBS/YR)	50058.	68503.	91740.	115551.	134991.	144256.
NEW SEPARATE SEWER AREA						

TWIN LAKES	1970	1980	1990	2000	2010	2020
POPULATION	0.	1630.	2220.	2804.	3282.	3583.
FLOW (MGD)	0.00	0.20	0.28	0.36	0.46	0.54
UOD (LBS/YR)	0.	110376.	150311.	194527.	227607.	255447.
SUSPENDED SOLIDS (LBS/YR)	0.	113442.	154373.	196440.	233596.	261997.
ORGANIC NITROGEN (LBS/YR)	0.	8953.	11862.	14949.	17490.	19120.
AMMONIA NITROGEN (LBS/YR)	0.	5148.	7881.	9931.	11620.	12777.
TOTAL PHOSPHORUS AS P (LBS/YR)	0.	7113.	1425.	11876.	13846.	15146.
SULFATE (LBS/YR)	0.	20049.	27331.	37074.	43164.	48371.
CHLORIDE (LBS/YR)	0.	11007.	17375.	27005.	31135.	35000.
NEW SEPARATE SEWER AREA						

RAVENNA	1970	1980	1990	2000	2010	2020
POPULATION	13441.	20334.	27164.	35604.	48200.	74415.
FLOW (MGD)	1.44	2.24	3.64	5.10	6.50	11.15
UOD (LBS/YR)	834000.	1400000.	2400000.	4000000.	4700000.	6000000.
SUSPENDED SOLIDS (LBS/YR)	834000.	1400000.	2400000.	4000000.	4700000.	6000000.
ORGANIC NITROGEN (LBS/YR)	71048.	114065.	148020.	312544.	363544.	396025.
AMMONIA NITROGEN (LBS/YR)	47602.	79038.	131565.	207650.	241533.	263112.
TOTAL PHOSPHORUS AS P (LBS/YR)	56926.	94520.	157335.	248324.	288843.	314650.
SULFATE (LBS/YR)	140102.	294041.	497777.	785646.	913841.	995486.
CHLORIDE (LBS/YR)	225741.	374870.	623916.	984733.	1145413.	1247748.
NEW SEPARATE SEWER AREA						

# CUYAHOGA RIVER WATERSHED

KENT	1970	1980	1990	2000	2010	2020
POPULATION	25365.	40800.	56100.	71900.	85100.	93700.
FLOW (MGD)	2.77	4.90	7.01	9.35	11.91	14.06
BOD (LBS/YR)	1577917.	2580560.	3788152.	4986263.	5901681.	6668096.
SUSPENDED SOLIDS (LBS/YR)	1666480.	2755020.	3870533.	5117481.	6056991.	6840098.
ORGANIC NITROGEN (LBS/YR)	135170.	217423.	298957.	383155.	453498.	499327.
AMMONIA NITROGEN (LBS/YR)	87805.	144452.	198622.	254562.	301296.	331745.
TOTAL PHOSPHORUS AS P (LBS/YR)	107375.	172747.	237527.	304424.	360313.	396726.
SULFATE (LBS/YR)	339777.	546536.	751487.	963136.	1139957.	1255158.
CHLORIDE (LBS/YR)	425878.	635032.	941919.	1207200.	1428828.	1573222.

NEW SEPARATE SEWER AREA

FISH CREEK	1970	1980	1990	2000	2010	2020
POPULATION	7659.	24041.	42462.	49604.	54690.	56900.
FLOW (MGD)	0.84	2.83	5.31	6.45	7.64	8.53
BOD (LBS/YR)	475241.	1579493.	2867246.	3440036.	3792750.	4049856.
SUSPENDED SOLIDS (LBS/YR)	503136.	1621767.	2944778.	3530563.	3892559.	4153098.
ORGANIC NITROGEN (LBS/YR)	40815.	128114.	226280.	264340.	291443.	303220.
AMMONIA NITROGEN (LBS/YR)	27117.	85117.	150337.	174623.	193630.	201454.
TOTAL PHOSPHORUS AS P (LBS/YR)	32428.	101781.	179784.	210021.	231557.	240914.
SULFATE (LBS/YR)	102596.	322041.	568800.	664470.	732600.	762204.
CHLORIDE (LBS/YR)	128445.	403648.	712437.	832451.	918245.	955411.

NEW SEPARATE SEWER AREA

HUDSON S D C	1970	1980	1990	2000	2010	2020
POPULATION	4860.	8340.	11500.	14100.	17600.	20600.
FLOW (MGD)	0.53	1.06	1.44	1.83	2.46	3.09
BOD (LBS/YR)	341513.	500783.	776537.	977835.	1220559.	1446204.
SUSPENDED SOLIDS (LBS/YR)	311393.	506421.	737524.	1003667.	1244679.	1403798.
ORGANIC NITROGEN (LBS/YR)	25419.	47108.	61383.	75133.	93790.	104777.
AMMONIA NITROGEN (LBS/YR)	17207.	31298.	40716.	49921.	62313.	72934.
TOTAL PHOSPHORUS AS P (LBS/YR)	20577.	37429.	48691.	59699.	74518.	87220.
SULFATE (LBS/YR)	65102.	118416.	154048.	188876.	235761.	275947.
CHLORIDE (LBS/YR)	81599.	148423.	193085.	236739.	295504.	345874.

NEW SEPARATE SEWER AREA

TABLE A-6-3 (Cont'd.)

## CUYAHOGA RIVER WATERSHED

AKRON	1970	1980	1990	2000	2010	2020
POPULATION	344477.	376222.	418211.	453304.	470361.	471068.
FLOW (MGD)	53.80	60.21	64.52	70.16	80.90	82.44
BOD (LBS/YR)	19882000.	20601970.	24423500.	26472140.	29185890.	29229760.
SUSPENDED SOLIDS (LBS/YR)	28252400.	31589700.	36635260.	39709410.	42920430.	42984940.
ORGANIC NITROGEN (LBS/YR)	1937849.	2005260.	2228645.	2415656.	2506553.	2510320.
AMMONIA NITROGEN (LBS/YR)	1221037.	1332261.	1480676.	1604922.	1665312.	1667816.
TOTAL PHOSPHORUS AS P (LBS/YR)	1400202.	1593219.	1770704.	1919288.	1991507.	1994501.
SULFATE (LBS/YR)	4612799.	5040618.	5602144.	6072232.	6300719.	6310189.
CHLORIDE (LBS/YR)	5790484.	6317941.	7021761.	7610972.	7827360.	7909230.
COMBINED SEWER AREA						
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MACEDONIA	1970	1980	1990	2000	2010	2020
POPULATION	9064.	18844.	25557.	30520.	33169.	35566.
FLOW (MGD)	1.00	2.26	3.19	3.97	4.64	5.33
BOD (LBS/YR)	562421.	1238313.	1725735.	2116560.	2300269.	2531409.
SUSPENDED SOLIDS (LBS/YR)	595505.	1272711.	1772377.	2172260.	2360802.	2576317.
ORGANIC NITROGEN (LBS/YR)	48302.	100441.	136193.	162641.	176758.	189931.
AMMONIA NITROGEN (LBS/YR)	32091.	66731.	90484.	108056.	117435.	125921.
TOTAL PHOSPHORUS AS P (LBS/YR)	38377.	79802.	108208.	124222.	140437.	150986.
SULFATE (LBS/YR)	121417.	252478.	342349.	409813.	444315.	474424.
CHLORIDE (LBS/YR)	152194.	316409.	421192.	512431.	550407.	577153.
NEW SEPARATE SEWER AREA						
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GREENWOOD	1970	1980	1990	2000	2010	2020
POPULATION	2999.	4540.	6080.	8240.	9600.	10160.
FLOW (MGD)	0.33	0.54	0.76	1.07	1.34	1.52
BOD (LBS/YR)	146048.	249532.	419552.	571400.	665760.	723138.
SUSPENDED SOLIDS (LBS/YR)	197034.	307134.	421648.	597482.	682380.	741080.
ORGANIC NITROGEN (LBS/YR)	15987.	24300.	32400.	43311.	51151.	54143.
AMMONIA NITROGEN (LBS/YR)	10618.	16145.	21520.	27174.	33989.	35971.
TOTAL PHOSPHORUS AS P (LBS/YR)	12698.	19307.	25743.	34888.	40646.	43017.
SULFATE (LBS/YR)	40173.	61083.	81445.	113379.	128597.	136048.
CHLORIDE (LBS/YR)	50353.	76562.	102083.	138349.	161184.	170586.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

## CUYAHOGA RIVER WATERSHED

STREETSBORO	1970	1980	1990	2000	2010	2020
POPULATION	4779.	8950.	12595.	15550.	18120.	19850.
FLOW (MGD)	0.53	1.07	1.57	2.01	2.98	2.98
BOD (LBS/YR)	296517.	588015.	850477.	1080819.	1256621.	1412823.
SUSPENDED SOLIDS (LBS/YR)	313980.	604347.	873463.	1109262.	1289690.	1449049.
ORGANIC NITROGEN (LBS/YR)	25467.	47695.	67119.	83052.	96561.	105781.
AMMONIA NITROGEN (LBS/YR)	16920.	31647.	44593.	55179.	64154.	70279.
TOTAL PHOSPHORUS AS P (LBS/YR)	20234.	37894.	53327.	65987.	76720.	84045.
SULFATE (LBS/YR)	64017.	119890.	168716.	208769.	242726.	265901.
CHLORIDE (LBS/YR)	80239.	150270.	211470.	261672.	304235.	331281.
NEW SEPARATE SEWER AREA						

AURORA WESTERLY	1970	1980	1990	2000	2010	2020
POPULATION	1570.	10428.	15565.	20472.	24621.	25995.
FLOW (MGD)	0.17	1.25	1.95	2.66	3.45	3.90
BOD (LBS/YR)	97418.	685120.	1051026.	1419733.	1707465.	1850193.
SUSPENDED SOLIDS (LBS/YR)	103149.	704151.	1079432.	1457094.	1752399.	1897633.
ORGANIC NITROGEN (LBS/YR)	8367.	55571.	82946.	109095.	131205.	138527.
AMMONIA NITROGEN (LBS/YR)	5959.	36920.	55108.	72481.	87171.	92035.
TOTAL PHOSPHORUS AS P (LBS/YR)	6647.	44152.	65102.	86678.	104249.	110063.
SULFATE (LBS/YR)	21031.	139633.	208501.	273733.	327810.	348210.
CHLORIDE (LBS/YR)	26360.	175080.	261140.	441759.	411380.	434450.
NEW SEPARATE SEWER AREA						

TWINSBURG	1970	1980	1990	2000	2010	2020
POPULATION	6432.	9140.	12690.	14450.	15450.	15670.
FLOW (MGD)	0.71	1.10	1.59	1.88	2.15	2.15
BOD (LBS/YR)	61130.	600413.	856492.	1012107.	1071457.	1115412.
SUSPENDED SOLIDS (LBS/YR)	422482.	617178.	880051.	1028479.	1019653.	1143409.
ORGANIC NITROGEN (LBS/YR)	34270.	48707.	67425.	77004.	82333.	83505.
AMMONIA NITROGEN (LBS/YR)	22772.	32360.	44929.	51160.	54701.	55480.
TOTAL PHOSPHORUS AS P (LBS/YR)	27233.	38699.	53729.	61181.	65415.	66347.
SULFATE (LBS/YR)	86160.	122475.	169989.	193565.	206960.	209907.
CHLORIDE (LBS/YR)	107993.	153461.	213065.	242615.	259405.	263099.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

## CUYAHOGA RIVER WATERSHED

SALON CENTRAL	1970	1980	1990	2000	2010	2020
POPULATION	8250.	10720.	12925.	14190.	13820.	12600.
FLOW (MGD)	0.91	1.29	1.62	1.84	1.93	1.89
BOD (LBS/YR)	511912.	704304.	872751.	984076.	958417.	896805.
SUSPENDED SOLIDS (LBS/YR)	542025.	723968.	836349.	1002973.	983638.	912800.
ORGANIC NITROGEN (LBS/YR)	43964.	57127.	63877.	75618.	73647.	67145.
AMMONIA NITROGEN (LBS/YR)	29209.	37954.	45761.	50240.	48930.	44610.
TOTAL PHOSPHORUS AS P (LBS/YR)	34930.	45388.	54724.	60080.	58514.	55348.
SULFATE (LBS/YR)	110513.	143100.	173137.	190082.	185126.	168783.
CHLORIDE (LBS/YR)	138517.	171989.	217011.	238250.	232038.	211554.

## NEW SEPARATE SEWER AREA

BEDFORD HTS.	1970	1980	1990	2000	2010	2020
POPULATION	13219.	21427.	27824.	32010.	34280.	34400.
FLOW (MGD)	1.45	2.57	3.48	4.16	4.80	5.17
BOD (LBS/YR)	820239.	1407753.	1878814.	2221240.	2377317.	2454824.
SUSPENDED SOLIDS (LBS/YR)	868485.	1446859.	1920593.	2274734.	2433078.	2517718.
ORGANIC NITROGEN (LBS/YR)	70444.	114134.	148274.	170698.	182678.	183747.
AMMONIA NITROGEN (LBS/YR)	46802.	75342.	95111.	113402.	121368.	122114.
TOTAL PHOSPHORUS AS P (LBS/YR)	55912.	87223.	117807.	139221.	149183.	149033.
SULFATE (LBS/YR)	173076.	231511.	277714.	324058.	341148.	344011.
CHLORIDE (LBS/YR)	221447.	313754.	401114.	437784.	471111.	471111.

## NEW SEPARATE SEWER AREA

BEDFORD	1970	1980	1990	2000	2010	2020
POPULATION	17052.	20000.	23000.	26000.	27800.	27800.
FLOW (MGD)	1.74	2.38	2.97	3.48	3.74	3.86
BOD (LBS/YR)	303372.	1152374.	1335760.	1541750.	1744000.	1724440.
SUSPENDED SOLIDS (LBS/YR)	1473440.	1730075.	2033640.	2312640.	2536750.	2536750.
ORGANIC NITROGEN (LBS/YR)	93434.	120244.	127363.	140636.	148146.	148146.
AMMONIA NITROGEN (LBS/YR)	62143.	72583.	84618.	93469.	98426.	98426.
TOTAL PHOSPHORUS AS P (LBS/YR)	74315.	86797.	101142.	111777.	117705.	117705.
SULFATE (LBS/YR)	235118.	274608.	320152.	353641.	372394.	372394.
CHLORIDE (LBS/YR)	294698.	344145.	401281.	443256.	466762.	466762.

## COMBINED SEWER AREA

TABLE A-6-3 (Cont'd.)

CUYAHOGA RIVER WATERSHED

<u>SOUTHERLY</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
POPULATION	651209.	734054.	845622.	926440.	973253.	974410.
FLOW (MGD)	101.59	117.45	138.68	155.64	167.40	170.52
BOD (LBS/YR)	35653660.	40189440.	49384300.	54194080.	60390340.	60462130.
SUSPENDED SOLIDS (LBS/YR)	54668490.	61623810.	74076460.	81156130.	88409330.	88914910.
ORGANIC NITROGEN (LBS/YR)	3470291.	3911773.	4506319.	4936998.	5186464.	5192631.
AMMONIA NITROGEN (LBS/YR)	2305605.	2598916.	2993923.	3280059.	3445801.	3449897.
TOTAL PHOSPHORUS AS P (LBS/YR)	2757218.	3107987.	3580361.	3922545.	4120751.	4125650.
SULFATE (LBS/YR)	8723269.	9833018.	11327530.	12410120.	13037210.	13052710.
CHLORIDE (LBS/YR)	10933800.	12324760.	14197990.	15554930.	16340920.	16360340.
COMBINED SEWER AREA						

<u>RICHFIELD</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
POPULATION	0.	5560.	8880.	10620.	11430.	12150.
FLOW (MGD)	0.00	0.67	1.11	1.38	1.60	1.82
BOD (LBS/YR)	0.	365292.	599622.	736497.	792670.	864776.
SUSPENDED SOLIDS (LBS/YR)	0.	375439.	615828.	755878.	813530.	886950.
ORGANIC NITROGEN (LBS/YR)	0.	29629.	47322.	56594.	60910.	64747.
AMMONIA NITROGEN (LBS/YR)	0.	19685.	31440.	37600.	40468.	43017.
TOTAL PHOSPHORUS AS P (LBS/YR)	0.	23541.	37598.	44965.	48395.	51443.
SULFATE (LBS/YR)	0.	74479.	118952.	142260.	153110.	162755.
CHLORIDE (LBS/YR)	0.	93352.	147095.	178310.	191910.	203998.

TABLE A-6-4

## MUNICIPAL WASTE LOAD PROJECTIONS

Constituent	Watershed	Year				
		1970	1980	1990	2000	2010
Population	Chagrin	10,209	22,718	49,292	66,614	79,974
	Cuyahoga	1,115,702	1,316,854	1,556,035	1,745,725	1,857,744
	Rocky	208,001	301,029	381,115	440,360	481,683
	Lake Erie	829,736	936,870	1,092,055	1,210,188	1,292,205
	TOTAL	2,163,648	2,577,471	3,078,437	3,462,887	3,711,606
Flow (MGD)	Chagrin	1.12	2.73	6.16	8.66	11.20
	Cuyahoga	169.36	203.26	244.73	280.38	307.17
	Rocky	22.88	36.12	47.64	57.25	67.44
	Lake Erie	119.55	138.54	164.89	187.07	206.91
	TOTAL	312.91	380.65	463.42	533.36	592.72
BOD (Lbs/Yr.)	Chagrin	633,468	1,492,572	3,328,422	4,619,679	5,546,196
	Cuyahoga	61,829,710	74,134,500	93,320,710	105,668,760	118,093,200
	Rocky	12,906,460	19,777,600	25,734,770	30,538,940	33,404,700
	Lake Erie	46,997,300	54,404,030	67,099,670	75,357,760	81,681,760
	TOTAL	122,366,938	149,808,702	189,483,592	216,185,139	240,725,856
Suspended Solids (Lbs/Yr.)	Chagrin	670,731	1,534,032	3,418,398	4,741,250	5,692,147
	Cuyahoga	91,800,514	107,494,700	126,699,048	142,201,377	151,007,511
	Rocky	13,665,660	20,326,980	26,430,300	31,342,610	34,283,760
	Lake Erie	65,733,090	73,984,560	89,016,610	98,988,190	108,287,360
	TOTAL	171,869,995	203,340,272	245,564,356	277,273,427	299,270,778
Organic Nitrogen (Lbs/Yr.)	Chagrin	54,404	121,064	263,677	354,986	426,181
	Cuyahoga	5,945,575	7,017,515	8,292,110	9,302,968	9,899,917
	Rocky	1,108,437	1,604,183	2,030,961	2,346,677	2,566,888
	Lake Erie	4,421,661	4,992,578	5,819,559	6,449,090	6,866,158
	TOTAL	11,530,077	13,735,340	16,405,307	18,453,721	19,759,144
Ammonia Nitrogen (Lbs/Yr.)	Chagrin	36,145	80,433	174,518	235,867	283,148
	Cuyahoga	3,950,142	4,662,320	5,509,140	6,180,737	6,577,341
	Rocky	736,427	1,063,793	1,349,337	1,559,093	1,791,226
	Lake Erie	2,937,679	3,316,986	3,866,419	4,284,669	4,575,049
	TOTAL	7,660,393	9,125,532	10,899,414	12,260,346	13,140,936
Total Phosphorus as P (Lbs/Yr.)	Chagrin	43,225	96,188	208,702	282,044	338,610
	Cuyahoga	4,723,881	5,575,556	6,588,250	7,155,897	7,597,766
	Rocky	880,676	1,274,556	1,613,639	1,864,482	2,039,444
	Lake Erie	3,513,100	3,966,706	4,623,759	5,123,933	5,471,194
	TOTAL	9,160,882	10,913,008	13,034,350	14,426,356	15,447,014
	Chagrin	90,261	79,974	13.54	11.20	382,165
	Cuyahoga	1,885,929	1,857,744	319.72	307.17	7,698,847
	Rocky	505,925	481,683	75.89	67.44	2,142,085
	Lake Erie	1,320,333	1,292,205	219.24	206.91	5,611,456
	TOTAL	3,802,448	3,711,606	628.39	592.72	15,834,553

MUNICIPAL WASTE LOAD PROJECTIONS

Constituent	Watershed	Year				
		1970	1980	1990	2000	2010
Sulphate (Lbs/Yr.)	Chagrin	136,755	304,319	660,291	892,328	1,071,291
	Cuyahoga	14,945,388	17,639,919	20,843,838	23,384,856	25,262,945
	Rocky	2,786,275	4,032,433	5,105,225	5,896,841	6,552,384
	Lake Erie	11,116,725	12,559,839	14,628,620	16,211,072	17,309,729
	TOTAL	28,983,143	34,526,510	41,237,984	46,387,097	51,002,651
Chloride (Lbs/Yr.)	Chagrin	171,409	381,735	827,613	1,118,449	1,342,763
	Cuyahoga	18,732,633	22,109,974	26,125,810	29,310,713	31,664,730
	Rocky	3,492,335	5,034,276	6,398,920	7,393,643	8,087,637
	Lake Erie	3,780,771	5,150,768	6,943,155	8,298,776	9,393,853
	TOTAL	26,177,148	32,696,753	40,295,528	46,121,581	50,015,373
						51,715,460

7. Reuse Potential - Water quality requirements are dependent upon the use for which the water is intended. Throughout the study area the water usage varies widely from the industrialized urban areas to the rural farmlands.

In an attempt to categorize water usage, the following groups were selected:

1. Public water supply - residential and commercial consumption.
2. Irrigation.
3. Agricultural - livestock consumption.
4. Recreation - swimming, boating, etc.
5. Fish - sustain fish and other aquatic life.
6. Industrial I - Cooling Water.
7. Industrial II - Boiler Feed Water (150-250 psi).
8. Industrial III - Food Processing Industry consumption.
9. Industrial IV - Steel Manufacture, General Industrial consumption.

Each of these categories requires a different quality of water. The importance of defining the water quality criteria is to give insight to the potential of waters in regard to their reuse by certain water consumption categories. Tables A-7-1 and A-7-2 summarize the allowable values of various water quality parameters by water usage category. The principle sources of this data were Water Quality Criteria by McKee and Wolf and the Report of the Committee on Water Quality Criteria, F.W.P.C.A.

TABLE A-7-1  
DOMESTIC WATER QUALITY REQUIREMENTS

	<u>Public Water Supply</u>	<u>Irriga- tion</u>	<u>Agricul- tural</u>	<u>Recrea- tion</u>	<u>Fish</u>
Biochemical Oxygen Demand (monthly average), mg/l	1.5 - 2.5	-	-	*	*
Fecal Coliform, MPN per 100 ml (monthly average)	5,000	*	*	200	*
Dissolved Oxygen, mg/l	$\geq 4$	*	*	*	$\geq 5$
pH (average)	6.0 - 8.5	6 - 9	*	6.5 - 8.3	6.0 - 9.0
Chlorides (max.), mg/l	250	100	1500	-	400
Fluorides, mg/l	1.7	10.0	1.0	*	1.5
Phenolic Compounds, (max.) mg/l	.001	50	1000	*	0.2
Color, units (platinum-cobalt, standard)	75	-	-	*	*
Turbidity, Jackson Units	10 - 250	-	-	*	50
Ammonia, mg/l	0.5	*	*	*	1.0
Dissolved Solids, mg/l	500	1000	2500	*	2000
Temperature, °F	85	-	-	85	$\leq 5^{\circ}$ greater than monthly average

\*No data available

-Not a critical parameter

TABLE A-7-2  
INDUSTRIAL WATER QUALITY REQUIREMENTS

	I	Industrial		IV
	Cooling	II	III	Steel
	Water	Boiler	Food	Manu.
		Feed	Processing	
Turbidity, Jackson Units	50	10	1-10	*
Hardness, mg/l as CaCO <sub>3</sub>	50	40	10-250	*
Iron, mg/l	0.5	*	0.2	-
Manganese, mg/l	0.5	*	0.2	-
Iron and Manganese, mg/l	0.5	*	0.2-0.3	-
pH	6.5-7.5	8.4	*	5 - 9
Fluoride, mg/l	*	*	1.0	*
Dissolved Solids, mg/l	*	50-3000	850	1500
Chlorides, mg/l	*	*	50	175
Color, units (platinum-cobalt standard)	-	2-80	10	-
Temperature, °F	100	120	*	100

\*No data available

-Not a critical parameter

There are several areas where reuse is presently being practiced either directly or indirectly. In the lower Cuyahoga River area, the effluent from the Southerly Plant along with the flow of Cuyahoga River water is being used for cooling purposes. In the upper Cuyahoga and in the Rocky and the Chagrin Rivers water is withdrawn for public water supply, and at least part of the volume withdrawn has had prior use. With development of the upper watersheds, it will become even more critical in the future to protect this reuse requirement by improving wastewater treatment. Table A-7-3 shows withdrawal and upstream uses.

TABLE A-7-3

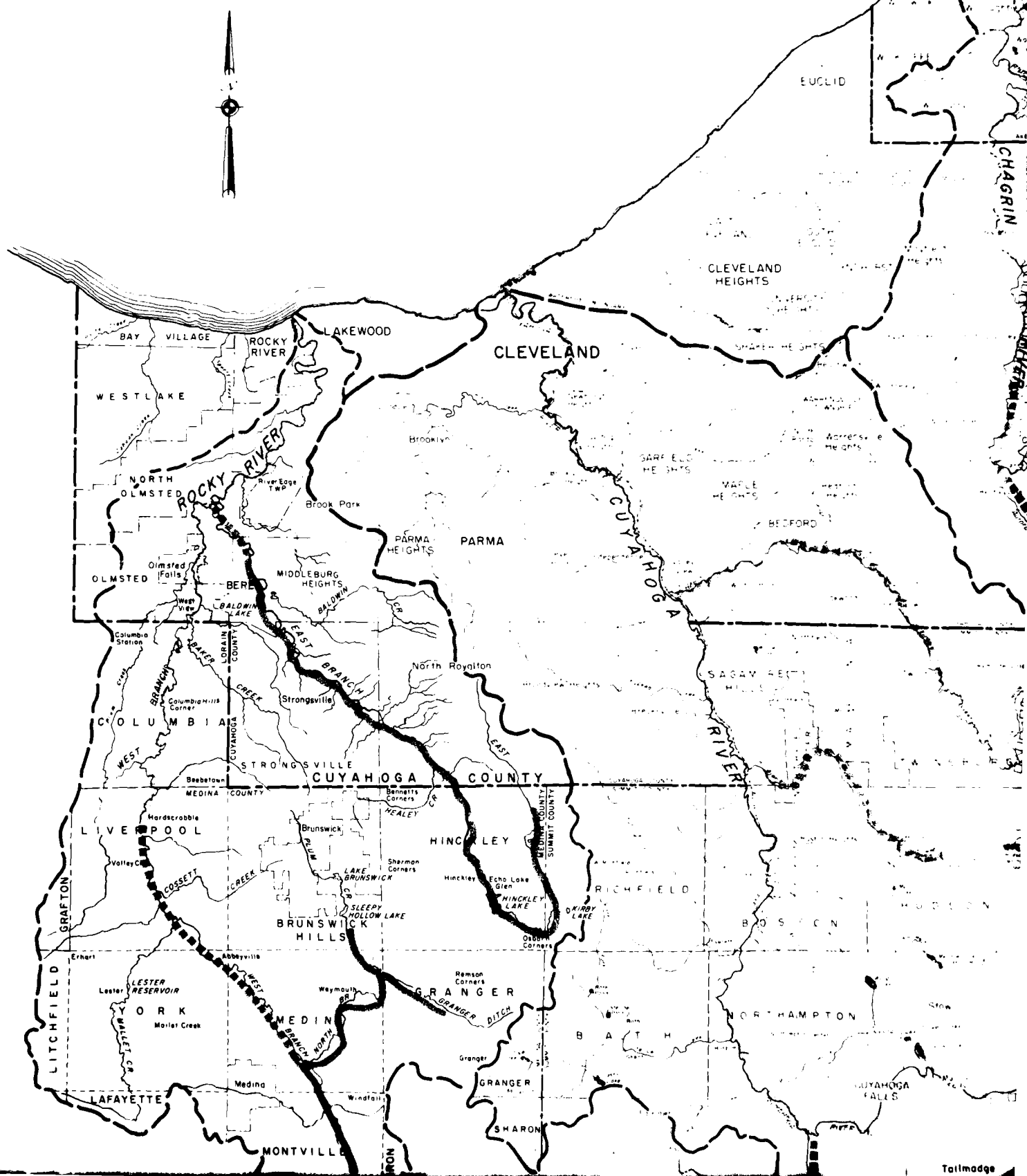
PRESENT REUSE

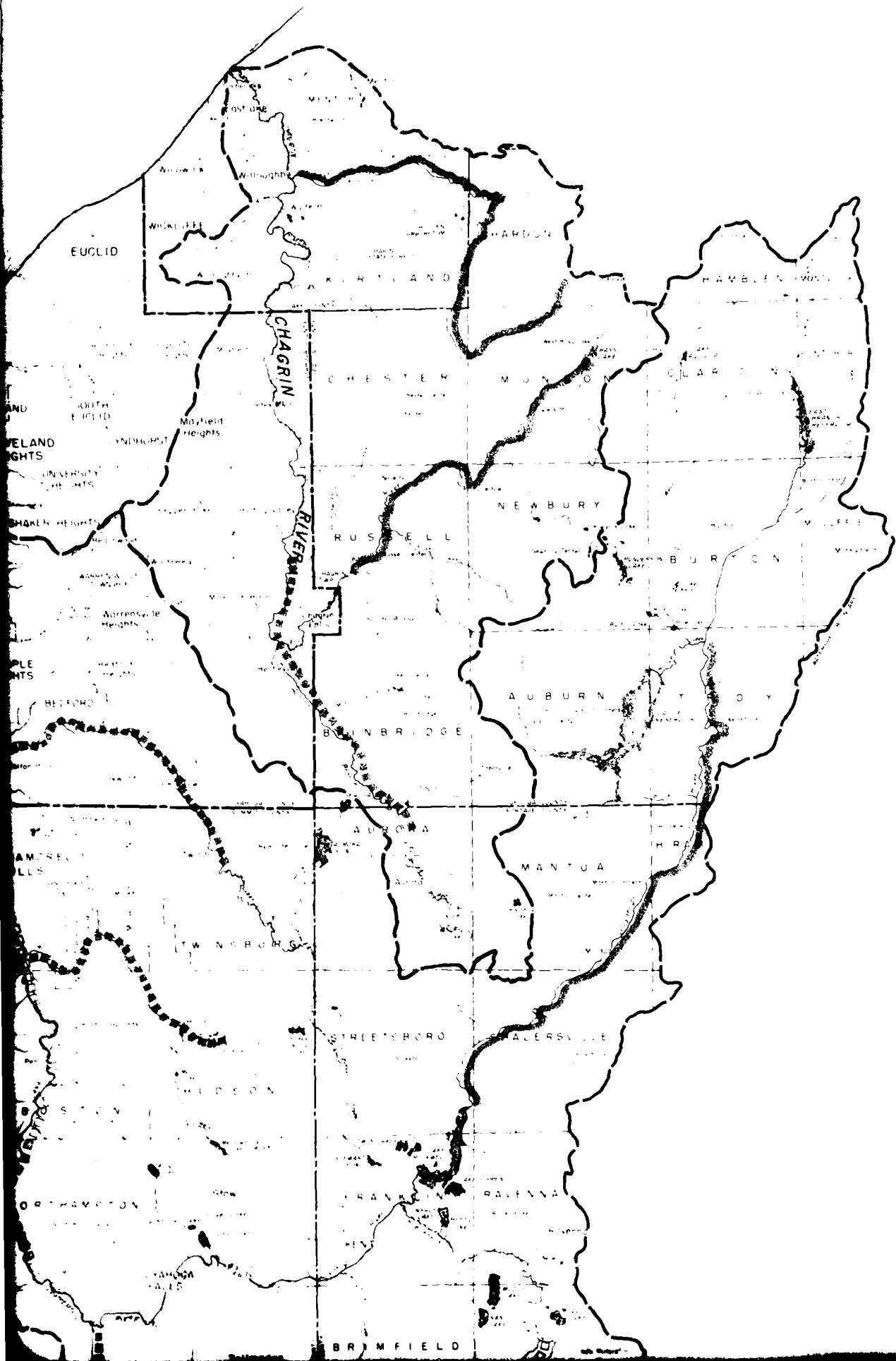
<u>Withdrawal</u>	<u>Use</u>	<u>Prior Major Users</u>
Lake Rockwell - Cuyahoga River	Public Water Supply for Akron	Mantua, Burton, Middlefield
Willoughby - Chagrin River	Public Water Supply for Willoughby	Chagrin Falls, Aurora, Chesterland
West Branch Rocky River	Medina Water Supply	Agricultural only
East Branch Rocky River	Berea Water Supply	Brunswick, Strongsville, North Royalton
Lower Rocky River	Recreation	Medina, Brunswick, Berea, North Royalton, Strongsville, North Olmsted, Brookpark, Middleburg Heights
Lower Chagrin River	Recreation	Chagrin Falls, Aurora, Chesterland
Lower Cuyahoga River	Industrial Water Supply and Cooling	Akron, Cleveland sewerage district, Central Cuyahoga River Watershed Communities

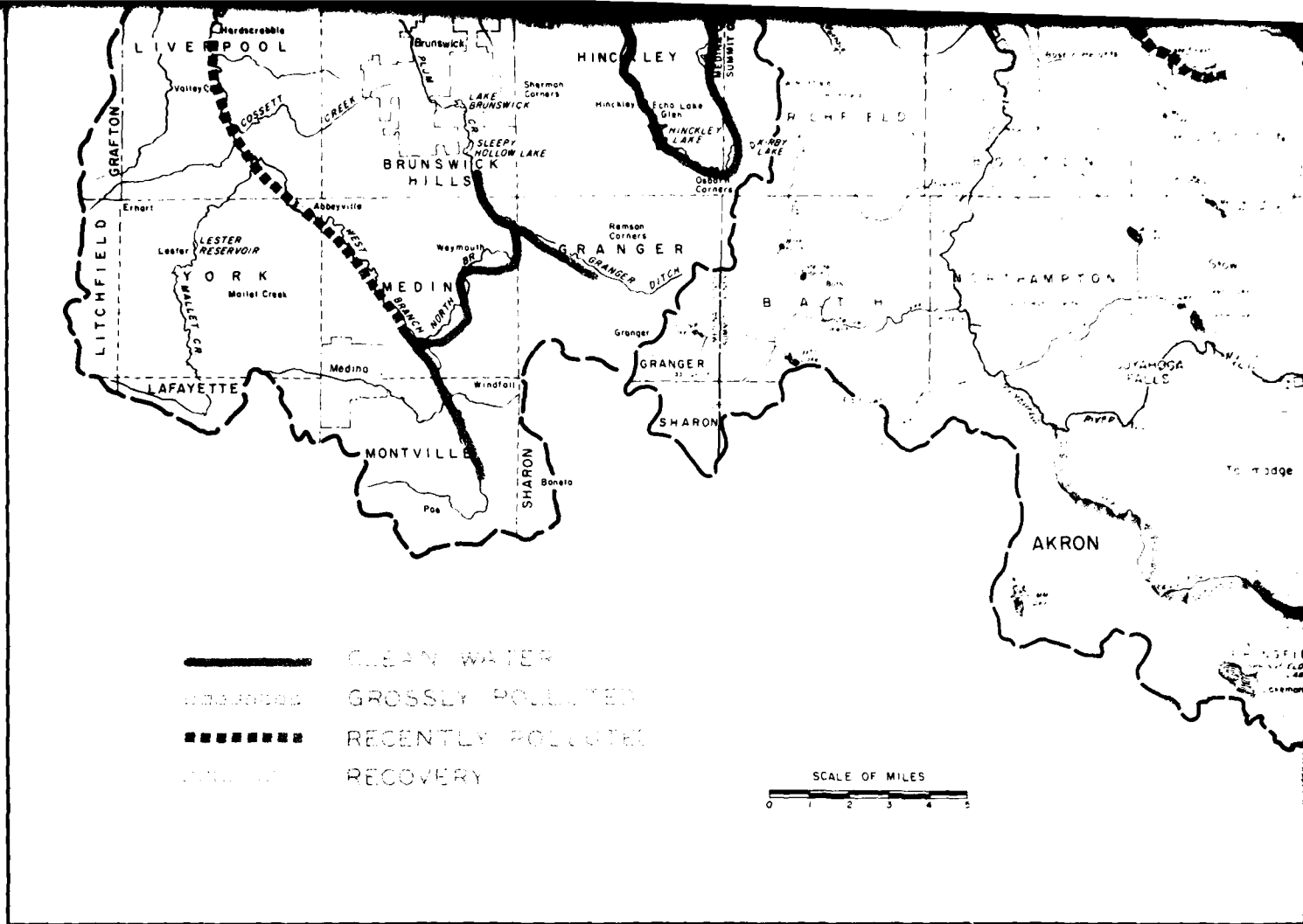
8. Stream Flow Quality - The feasibility report indicates major stream quality conditions and Figure A-8-1 indicates the general water quality zones. Additional information on the Cuyahoga River indicates that the reach from the Ohio Edison dam to the confluence with the Little Cuyahoga River does not continuously meet the temperature standard for Aquatic Life "A", stated in the Feasibility Report.

The stream water quality criteria has been revised by the Ohio Water Pollution Control Board. The revision upgrades the Aquatic Life "B" classification to Aquatic Life "A" class, and modifies the industrial water supply, recreation, and aquatic life criteria. The most recent water quality criteria is shown in Table A-8-1.

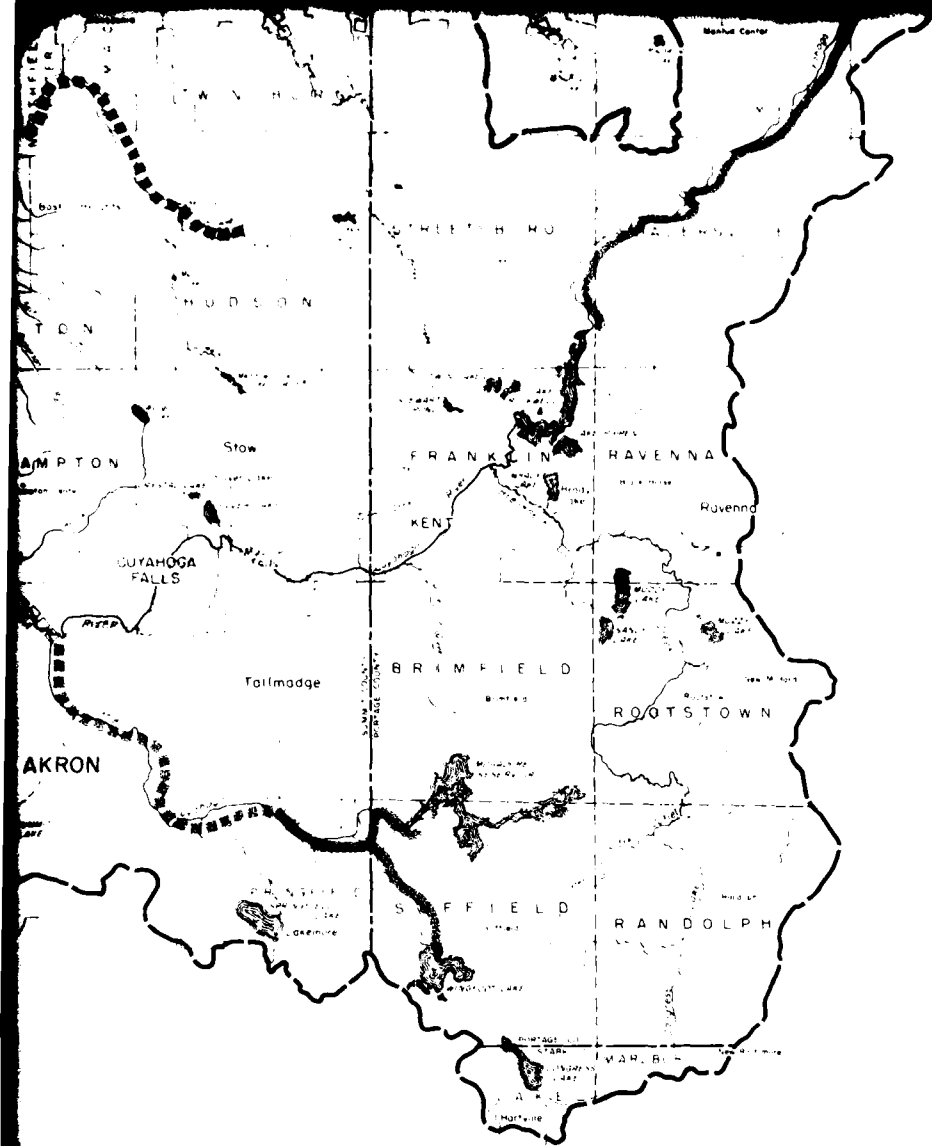
# LAKE ERIE







3



1A

**SURVEY SCOPE STUDY  
WASTEWATER MANAGEMENT PROGRAM  
CLEVELAND-AKRON METROPOLITAN  
AND  
THREE RIVERS WATERSHED AREAS**

**U. S. ARMY ENGINEER DISTRICT, BUFFALO**

*Final Report*

1 5

A-62

SUMMARY OF

CUYAHOGA RIVER OHIO DEPARTMENT OF HEALTH WATER QUALITY STANDARDS

	Aquatic Life Warm Water Fisheries	Industrial Water Supply	Public Water Supply	Recreation	
				Secondary Contact	Primary Contact
Cuyahoga River from S.R. 17 to Coast Guard Station:	X	X			
Cuyahoga River from Lake Rockwell Down to S.R. 17:	X			X	
Little Cuyahoga River upstream of S.R. 91 and downstream of Hazel Street, Akron:	X	X		X	
Little Cuyahoga River between S.R. 91 and Hazel Street; Summit Lake and the Ohio Canal:	X	X			
All other tributaries between Lake Rockwell and Harvard Avenue, Cleveland:	X	X		X	
Upper Cuyahoga River Basin above Lake Rockwell Dam:	X	X	X		X
Lakes, Hodgson, Muzzy and Sandy	X	X	X		X
Lakes, currently in use for swimming and water contact sports	X	X			X

TABLE A-8-1 (Cont'd.)

SUMMARY OFCHAGRIN RIVER OHIO DEPARTMENT OF HEALTH STANDARDS

<u>Reach</u>	<u>Aquatic Life</u>		<u>Industrial Water Supply</u>	<u>Public Water Supply</u>		<u>Cold Water Fish-Seasonal</u>	<u>Recreation</u>	
	<u>Warm Water Fisheries</u>						<u>Secondary Contact</u>	<u>Primary Contact</u>
Chagrin River and all tributaries	X		X				X	
East Branch and Main Stem near Daniels Park	X		X	X			X	
Main Stem upstream of Chagrin Falls	X		X				X	
Aurora Branch	X		X				X	
East Branch	X		X			X	X	

<u>Chagrin River and all tributaries:</u>		<u>East Branch and Main Stem near Daniels Park:</u>	<u>East Branch:</u>
<u>Requires:</u>	<u>4 freedoms:</u>	In addition, required threshold odor number: Not to exceed 24 at 60°C as a daily average.	<u>Requires:</u> 4 freedoms
Bacteria:	Fecal Coliforms 1,000/100 ml, mo. geo. mean 2,000/100 ml, 10% samples	Bacteria: Total Coliforms 5,000/100 ml, mo. avg. 20,000/100 ml, 5% samples	D.O.: 6.0 mg/l, all times
Diss. Solids:	500 mg/l, mo. avg. 750 mg/l, any time		pH: 6.5-8.5
D.O.:	5.0 mg/l, daily avg. 4.0 mg/l, any time		Temperature: Natural, no heat added
pH:	6.0 - 8.5		Toxicity: 1/10 96 hr. median tolerance limit.
Temperature:	90°F. (Max.)		
Toxicity:	1/10 96 hr. median tolerance limit		

## SUMMARY OF

## ROCKY RIVER OHIO DEPARTMENT OF HEALTH STANDARDS

Reach	Aquatic Life		Industrial Water Supply	Public Water Supply	Recreation	
	Warm Water Fisheries				Secondary Contact	Primary Contact
Rocky River and all tributaries	X		X		X	
East Branch and Baldwin Creek near reservoir	X		X	X		
East Branch at Albion Park	X		X		X	X

## Rocky River and all tributaries:

Requires: 4 freedoms:

Bacteria: Fecal Coliforms  
1,000/100 ml, mo. geo. mean  
2,000/100 ml, 10% samples

Diss. Solids: 500 mg/l, mo. avg.  
750 mg/l, any time

D.O.: 5.0 mg/l, daily avg.  
4.0 mg/l, any time

pH: 6.0 - 8.5

Temperature: 90°F. (Max.)

Toxicity: 1/10 96 hr. median  
tolerance limit

## East Branch and Baldwin Creek near reservoir:

In addition, requires threshold odor number: Not to exceed 24 at 60°C as a daily average.

Bacteria: Total Coliforms  
5,000/100 ml, mo. avg.  
20,000/100 ml, 5% samples

## East Branch at Albion Park:

Same as Rocky River except coliforms.

Fecal Coliforms:

200/100 ml, mo. geo. mean  
400/100 ml, in more than 10%  
of monthly sample

9. Sediment Deposits in the Three Rivers Watershed Area - Sediment deposits occur along rivers and streams where the velocity of the river is reduced due to an increase in cross sectional area. This can be caused by natural formations or man-made dams or impoundments. Tables A-9-1, A-9-2 and A-9-3 tabulate the characteristics of the impoundments in the Chagrin River Basin, the Cuyahoga River Basin, and the Rocky River Basin, respectively. Table A-9-4 lists the Natural Lakes and Impoundments for each of the watersheds.

Following is a written description of the sediment deposit areas by watershed.

#### a. CHAGRIN RIVER

##### Main Branch - Bass Lake to Aurora Branch

Bass Lake - The outlet for several miles has a low gradient and has been dredged. Most recent dredging or channeling is in the Butter-nut Road-Cochran Road reach. Banks and substrate are not stable and contribute silt and organics to the stream flow.

Chagrin Falls - Chase Bag Co. Two impoundments, approximately ten feet deep. A third dam, ten feet in height, but holding a narrow pool of an estimated five or six acres, is located below the Chase Bag Co. impoundment and in the center of the town. It also is nearly full, but flushing action of high flows keeps the pool depths at an estimated one to three foot depth. Much of the fill appears to be gravel and rock slabs to a size of at least one foot.

Below this dam is a steep section in which the river drops about 40 feet in about 150 yards.

##### Main Branch - Aurora Branch to Lake Erie

From the confluence of the Aurora Branch with the Main Branch of the Chagrin River near Chagrin Falls Village to State Route 84 at Willoughby, small sediment beds made up of sills, sand and gravel are frequent. North of Mayfield Road some channel clearing operations have been carried out to maintain a freely flowing channel. Bank erosion is common to this entire reach, with sediments building on the inside of curves at and below the outside curve cutbanks.

Dam at Gates Mills Village - This impoundment holds an estimated 12-15 surface acres of flowing pool, approximately six feet deep. It is about one-half filled with rock debris, and sandy gravel.

Construction of Interstate 90 was accompanied by relocation of

the river channel on the flood plain in that area. Erosion was rapid and locally severe in this reach for several years but now the banks seem to be stabilizing.

Willoughby Dam and Pool - This is a six foot high dam impounding the main River for Public Water Supply. There are two intakes, one in the Main Branch about 150 feet above the dam, and the other in the East Branch near the head of the backed up pool. In general, the entire pool is filled to within one and one-half to three feet of the surface with sand, gravel, silt and organic matter. Annually, usually in June, the dam gate is opened to lower the water level. Bulldozers are used to push some of the sediments out and below the dam from the dam fact to the first intake and for a 100 foot width. The remainder of the pool has not been cleaned for several years. A sediment island in the pool south of State Route 84 bridge was removed in 1965. Silt deposits below the East Branch intake were removed in 1963. This bed has not rebuilt as rapidly as prior to 1963. This may be due in part to operational improvements at the upstream gravel pits.

The last two miles of the river course is estuarine. Silt beds form throughout. Basin sludge and filter wash from the Willoughby water plant are added to the river sediments.

#### Aurora Branch

No serious sediment accumulations were found. Except for Sunny Lake, impoundments are located on intermittent streams. Sunny Lake does not appear to have unusual silting problems.

#### East Branch

Generally high gradient with eroding type but generally stable bed. One or two reaches in the lower two-thirds of the streams course accumulate gravel and silt. One is the reach near Booth Road, Kirt-

land Hills Village, the other is at and just above the confluence and pool at Willoughby. Formerly a problem with washings from gravel operations were serious on the East Branch.

#### b. CUYAHOGA RIVER

##### From the Headwaters to Lake Rockwell

No sedimentation was found in this upper reach. As the river enters Lake Rockwell, as observed from State Route 14, extensive marshy island areas evidence sediment deposits in the lake area upstream from the highway.

##### Lake Rockwell to Kent

The reach from Lake Rockwell to Kent does not appear to have a sediment problem at this time, although Breakneck Creek, a tributary, has a continuing tendency to fill much of its own channel with silts including organics. Much of the organic matter is of natural origin. The creek channel east and northeast of Kent was dredged about two years ago.

##### Kent to Munroe Falls

From Kent to the Munroe Falls Dam, the Cuyahoga River is in a pool. Prior to 1969, a heavy organic load from the Kent Wastewater Treatment Plant helped to form a sludge bed and septic condition throughout the pool, a reach of about four miles. Improved treatment at the plant has removed the load and the river has shown marked recovery. Munroe Falls Dam has a height of approximately 12 feet. Measurement at the abutment indicated filling of about eight feet.

##### Old Gorge Reach

Through Cuyahoga Falls and North Akron the current scours and carries sediments at least as far as the Ohio Edison Generating Plant pool. Several small dams in the gorge reach do not appear to collect

much sediment. A few small marginal beds two to three inches deep occur in the upper pool at Cloverbrook Road. Sandstone bedrock is the substrate here.

The Ohio Edison dam holds a pool approximately 50 feet deep. Measurement at the State Route 59 bridge showed 23 feet of water over a soft substrate. It is not certain as to the distribution of sediment in the pool.

#### Akron Wastewater Treatment Plant to Peninsula

The reach above the treatment plant does not collect sludge or much silt. Sand and gravel and stable aluvial soil make up the stream substrate. Bars of gravel and sand build and shift at bends.

Although improved capacity and treatment at the Akron spill out has apparently reduced the solids load to the river some sludge still forms in downstream beds.

At Ira Road bridge the substrate is generally clean gravel and sand with a strong current. At Bolanz Road bridge the current is slower and sediments build on the left side of the channel. These sediment beds appeared to be one to two feet deep.

Septic conditions were also observed last summer in the flowing pool above the dam at Peninsula, State Route 303. The dam is about 12 feet high with the pool confined to the river bed. It is approximately one-half filled with silts, sand, gravel, rocks and some organics. This varies with flow conditions, with the lighter material building during moderate and low flow. These tend to be flushed out during high flows.

#### Peninsula to Station Road, Brecksville

Bank erosion is common. River meanders have cut banks and built up sediments on inside of bends. Previously there has been an

extensive sludge bed at the head of the pool behind the dam at Station Road. Summer conditions may make this bed evident again. Reduction in its size and activity would probably reflect treatment improvement at Akron.

The dam at Station Road diverts water into the Ohio Canal. The canal reach to the first lock and spillway at Alexander Road showed considerable septic activity on May 9 and 10, particularly in the quarter mile reach above the spillway.

Considerable aeration takes place at the spillways and no further septic bubbling was noticed throughout the remainder of the canal. The canal collects considerable silt and sludge sediments.

#### c. ROCKY RIVER

##### West Branch Above East Branch

In the upper watershed of the West Branch sediments are not a problem. The impoundment on the North Branch at the Medina Water Plant holds a pool about six feet deep and covering three to four surface acres. It is about eighty percent filled with silt, sand and gravel.

At Fenn Road a fallen tree is forcing a new channel cut that has removed about ten feet of bank in the past year.

In the low gradient reaches from this vicinity to Westview near Berea the river accumulates silts and heavier sediments during moderate and low flows. High flows tend to move these with final deposit in Lake Erie.

A low dam at Westview, maintained to supply irrigation water for greenhouse use in that area, collects rocks, gravel and tree debris. The pool is narrow and confined to the river bed.

The next reach to the confluence with the East Branch is a high

gradient and does not collect light sediments.

#### West Branch - East Branch Confluence to Lake Erie

Re-channeling of some reaches of Rocky River below the confluence has kept the current sufficient to prevent further sediment bed formation to the mouth. The estuary at the mouth collects sediment and sludge from three upstream wastewater plants and combined sewerage system. Septic conditions occur at the head of the estuary pool

#### East Branch Above Berea

No sediment beds were found to the impoundments at Berea. These are abandoned quarry holes and are reported to be 70 to 90 feet in depth, the general thickness of the sandstone in the area. Baldwin Lake on the river is used as public water supply by the City of Berea.

Sediments have collected to nearly the total capacity of the reservoir lake. Dredging in 1961 removed a few feet of the top layers. Much of this capacity has been lost to refilling. Water depths over large areas of the reservoir are only one to three feet.

Disposal of this large volume of sediments would be a serious problem.

Included in the area is Wallace Lake, a recreation lake near Baldwin Lake.

#### Berea Confluence with West Branch

This reach collects silts and sludge in low flow periods particularly in short low gradient sections. This sludge originates from the Berea Wastewater Plant. Recent improvements in effluent quality have reduced the size and impact of these sludge beds.

TABLE A-9-1

IMPOUNDMENTS IN CHAGRIN RIVER BASIN

<u>Location of Impoundment</u>	<u>Dam Height</u>	<u>Pool Acres</u>	<u>% Fill</u>	<u>Type of Fill</u>
CHAGRIN RIVER:				
Sunny Lake, Aurora	less than 10'	65	Unknown	-
Chase Bag Co., Chagrin Falls	(1) 10'	16.5	90	silt, gravel, cobble
	(2) 10'	14.7	90	silt, gravel, cobble
Chagrin Falls	10'	5	85	silt, gravel, cobble
Gates Mills	6'	10	50	silt, gravel, cobble, boulders
Willoughby Water Plant	6'	8	80	silt, gravel

\*Impoundment raises natural ponds

TABLE A-9-2

IMPOUNDMENTS IN CUYAHOGA RIVER BASIN

<u>Location of Impoundment</u>	<u>Dam Height</u>	<u>Pool Acres</u>	<u>% Fill</u>	<u>Type of Fill</u>
CUYAHOGA RIVER:				
East Branch Reservoir	greater than 10'	400	Unknown	
Lake Rockwell Reservoir	greater than 10'	736	Unknown	
Kent	less than 5'	5	10	silt, gravel
Munroe Falls	8'	96	50	silt, gravel, sludge, lime
Cuyahoga Falls	12'	10	Unknown	
	10'	2	Unknown	
Ohio Edison Power	greater than 50'	38	50	silt, gravel, sludge
Peninsula	less than 10'	10	50	silt, gravel, cobbles, boulders, sludge
Canal Diversion Dam	less than 10'	15	50	silt, gravel, sludge

TABLE A-9-3

IMPOUNDMENTS IN ROCKY RIVER BASIN

<u>Location of Impoundment</u>	<u>Dam Height</u>	<u>Pool Acres</u>	<u>% Fill</u>	<u>Type of Fill</u>
ROCKY RIVER:				
Medina Water Plant	7'	6	80	silt, gravel, sand
Westview	8'	6	40	silt, sand, gravel, cobbles
Olmsted Falls	4'	1	40	gravel, cobbles, boulders
Hinckley Lake	18'	81		
Baldwin Lake	7'	33	95	silt, sand, gravel
Oxbow Dam	less than 10'	1	70	silt, sand, gravel, cobbles

TABLE A-9-4  
NATURAL LAKES AND  
IMPOUNDMENTS ON TRIBUTARIES OF THREE RIVERS

<u>Chagrin</u>	<u>Cuyahoga</u>	<u>Rocky</u>
N Bass Lake	I LaDue Reservoir	I Montiville Lakes
I Lake Lucerne(s)	I Restfull Lake	I Lake Brunswick
	N Punderson	I Sleepy Hollow Lake
	N Sandy Lake	Q Wallace Lake - Quarry
	NI Muddy Lake	Q Coe Reservation
	N Muzzy Lake	I Lester Lakes(s)
	I Mogadore Res.	
	I Lower Mogadore	
	N Springfield Lake	
	I Massilon Road Gage	
	NI Wyoga Lake	
	I Meadowbrook Lake(s)	
	I Lake Forest	
	I Pine Lake	
	I Hudson Springs Lake	
	NI Aurora Pond	
	I Ghent Millpond	

s = sediment problem  
N = Natural Lake  
I = Impoundment  
Q = Quarry

## B - STORMWATER RUNOFF

1. Drainage District - The study area was divided into 162 storm drainage districts. The work maps used for this were USGS 1:24000 topographic maps and the land use maps prepared for this study. The drainage districts used in present urban areas were those that are defined by the local storm sewer system. In areas where storm sewer systems have not been installed, then the district was laid out according to normal engineering practice. The districts were identified by the type of systems - natural channel, separate storm sewer or combined sewer.

Future districts were considered to be separate. The 162 districts divide the study area into storm sewer districts that would be capable of providing drainage for the 2020 urban area. Rural areas were not sub-divided.

2. Rainfall - Rainfall intensities and depths were based on the local raingage records and U.S.W.B. Bulletin 40. The local records consisted of the official weather station at Cleveland Hopkins International Airport and six other gages which have records of varying periods. This data had been collected and arranged under prior contracts. The results are shown in Table B-2-1 for depths and intensities for various durations and frequencies. Table B-2-2 shows rainfall depths for 1 day through 10 day durations as interpolated from U.S.W.B. Bulletin 49.

TABLE B-2-1

RAINFALL DEPTHS AND INTENSITIES

Maximum Depths for Various Durations (inches)

<u>Frequency</u>	<u>15 Min.</u>	<u>30 Min.</u>	<u>1 Hr.</u>	<u>2 Hr.</u>	<u>4 Hr.</u>	<u>6 Hr.</u>	<u>12 Hr.*</u>
6 Months	.47	.56	.66	.82	.86	.90	-
1 Year	.60	.78	.90	1.04	1.08	1.14	1.70
3 Years	.86	1.10	1.30	1.46	1.50	1.58	-
5 Years	.99	1.28	1.50	1.66	1.70	1.80	2.70
10 Years	1.13	1.55	1.80	2.10	2.20	2.30	3.0

Maximum Intensities for Various Durations (in./hr.)

6 Months	1.87	1.12	.66	.42	.22	.15
1 Year	2.42	1.56	.90	.52	.27	.19
3 Years	3.42	2.20	1.30	.73	.37	.26
5 Years	3.96	2.56	1.50	.83	.42	.30
10 Years	4.52	3.10	1.80	1.05	.55	.38

\*Depths for 12 hr. duration were obtained from U.S.W.B. Bulletin 40.

TABLE B-2-2  
RAINFALL DEPTHS FOR LONG DURATIONS

<u>Frequency</u>	<u>Duration (Days)</u>				
	<u>1</u>	<u>2</u>	<u>4</u>	<u>7</u>	<u>10</u>
1 Year	2.15				
2 Year	2.40	2.7	3.4	3.7	4.1
5 Year	3.00	3.3	3.8	4.5	5.0
10 Year	3.40	3.8	4.3	5.0	5.7

Areal distribution was accounted for in the hydrograph development by ratios of overall area rainfall to the maximum point rainfall. The rainfall data was all based on point rainfall records. The following table shows the ratios that were compiled from several sources as well as by Havens and Emerson for the Cleveland area.

TABLE B-2-3  
RATIO OF OVERALL AREA RATE TO  
MAXIMUM POINT RAINFALL

<u>Area/Duration</u>	<u>30 Min.</u> (Marston)	<u>60 Min.</u> (Marston)	<u>6 Hr.</u> (H & E)
Point Rainfall	1.0	1.0	1.0
1,000 Acres	0.90	0.95	-
2,000 Acres	0.85	0.93	0.97
4,000 Acres	0.80	0.88	0.96
8,000 Acres	0.75	0.85	0.93
10,000 Acres	-	-	0.92
20,000 Acres	-	-	0.87

After consulting with the contract officer, a separate document was prepared on the selection of the design storm. This document is attached as Appendix A.

3. Drainage Criteria - For all 162 drainage districts, the basic data was gathered. This consisted of measuring the total area, the area of open space and the length and slope of the drainage course. This data has been put in tabular form on work sheets and is attached as Appendix B.

The average sizes of the drainage districts were:

	<u>Average (acres)</u>	<u>Range (acres)</u>
Cuyahoga	3200	340 - 23774
Rocky	2700	266 - 8145
Chagrin	1850	460 - 4440
Lake Erie Direct	7000	2800 - 23396

All measurements were made on the work maps - USGS 1:24000.

4. Runoff Factors - With the techniques chosen to develop hydrographs, it was necessary to determine the imperviousness of each drainage district. This imperviousness factor was then used to compute the runoff factor. This computation is discussed in the section on hydrographs. The imperviousness factors were based on several in-field measurements in selected areas which were in turn compared to aerial photographs. For areas where recent aerial photographs were not available, comparisons were made to USGS maps and local street maps.

As many of these areas develop the imperviousness factors will increase. In order to project this change, some typical drainage districts were selected and synthetically urbanized as a function of the projected populations. Homes were increased at a rate equal to the growth rate per decade. For example, in one selected area there were 948 homes and the 1970-1980 growth ratio was 1.4 making the estimated number of homes in 1980 as 1,327. Roads were increased by the same rate. An additional imperviousness percentage was added to account for an increase in commercial buildings, schools, parking lots and industrial buildings. This percentage ranged from 2 to 6 percent.

Each drainage district was then individually compared to the selected examples and the imperviousness factor selected. The land use maps were used as a guide but several factors were considered, such as distance from central cities, highway systems, present trends of development, and topography. The areas were done independently by two people and reviewed by a third to reduce judgmental bias.

This information has been prepared in tabular form by decade and is attached in work sheet form as Appendix C.

5. Hydrographs - A generalized unit graph was developed using the results of gaging data from 21% of the urban area. This data was gathered under previous studies, and the individual watersheds were analyzed separately. A unit graph for each was developed using stream gaging data and rainfall data gathered over a period of about two years. The unit graphs were compared and correlated to arrive at a general or average unit graph with the shape and geometric dimensions as shown on Figure B-5-1.

Peak flow rates of available unit hydrographs were plotted in a curve that shows the relation between peak flow rates and drainage area and is shown on Figure B-5-2. The equation for this curve was computed as:

$$Y_3 = 15 + \frac{235}{DA} - \frac{80}{DA^2}$$

Where  $Y_3$  = unit hydrograph peak - cfs/1,000 acres  
 $DA$  = Drainage area - acres

This equation was used to compute the peak flow ( $Y_3$ ).

Knowing  $Y_3$ , the area under the unit graph which represents 1" of runoff, and the geometric dimensions in terms of  $Y_3$  and  $X_3$  can be computed. Since the runoff volume is a function of the drainage area, the equation can be related to drainage area by the following equation:

$$X_3 = \frac{2122 DA}{Y_3}$$

After computing  $Y_3$  and  $X_3$ , other points of the unit hydrograph were calculated by utilizing ratios shown on Figure B-5-1. Computed unit hydrographs compared closely with available graphs - See Fig. B-5-3.

This average unit graph was, in turn, used to predict hydrographs of the individual areas for various rainfalls. Figures B-5-4 and B-5-5 show the results of this general unit graph verification.

A six-hour design storm was selected at various frequencies including: 6 months, 1-year, 3-year and 5-year. The storm duration was divided into 15-minute rainfall periods and the most intensive 8 periods were used eliminating periods

at the beginning and end of the storm with rainfall depth of .01-inch.

The rainfall excess was computed according to the following equation:

$$DE = C \times \text{Imp. Ratio} \times DT + \text{Perv. Ratio} (DT - DL)$$

Where DE = Depth of excess rainfall  
C = Coeff. of runoff from impervious areas  
DT = Total depth of rainfall in 15-minute period  
DL = Depth of rainfall lost by infiltration. This depth was computed by an equation to account for intensity and duration of rainfall.

Excess rainfall from eight 15-minute rainfall periods was applied to the unit hydrograph previously described and the total hydrograph for each design storm was computed. These computed hydrographs were compared with available hydrographs of five drainage areas. Peak flows and volume checked closely.

Using this technique and the data described in Sections 2, 3 and 4, hydrographs for the 162 drainage districts were computed. The hydrographs for the 1-year storm are assembled by river basin presented in Appendix D.

Appendix E lists the available supplemental data for the hydrographs for the 5, 10 and 100 year storms.

Appendix D consists of 163 pages of computer output sheets and Appendix E consists of 326 pages of output sheets. Due to the massiveness of this data, it has not been included in this report but will be available upon request to interested parties.

GEOMETRIC RATIOS OF GENERAL UNIT HYDROGRAPH

$\frac{X_2}{X_3}$	$\frac{X_4}{X_3}$	$\frac{X_5}{X_3}$	$\frac{X_6}{X_3}$	$\frac{Y_2}{Y_3}$	$\frac{Y_4}{Y_3}$	$\frac{Y_5}{Y_3}$
0.45	1.84	3.84	9.43	0.14	0.40	0.16

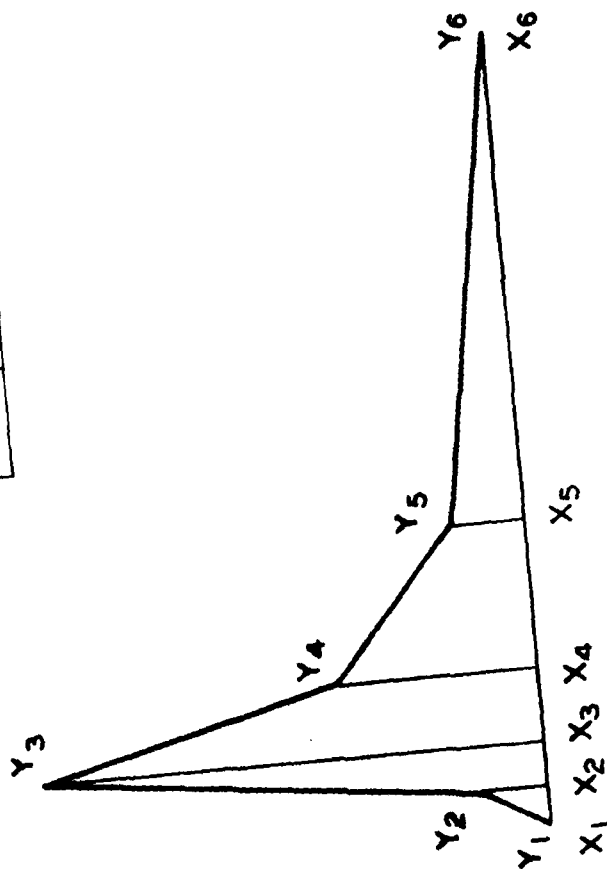
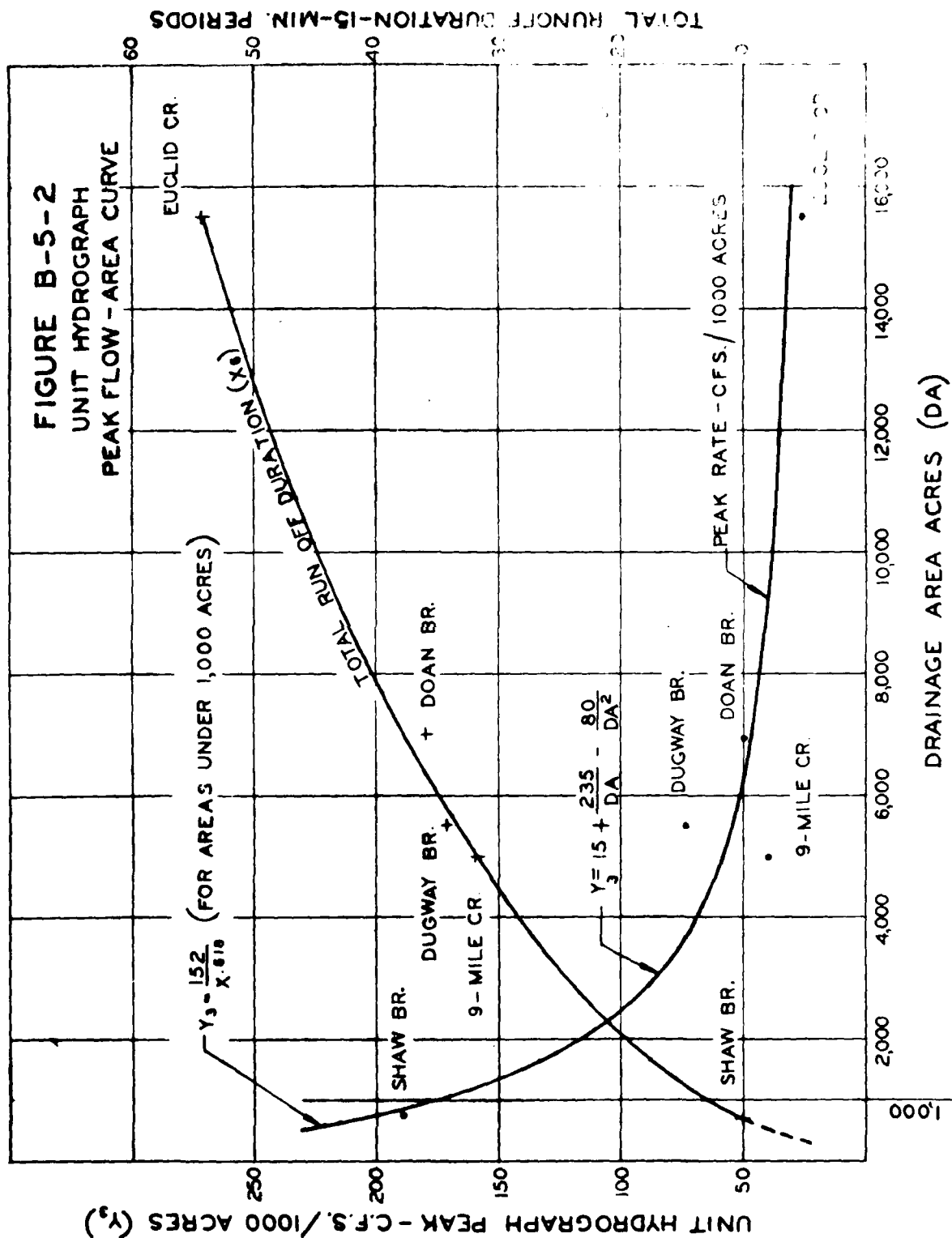
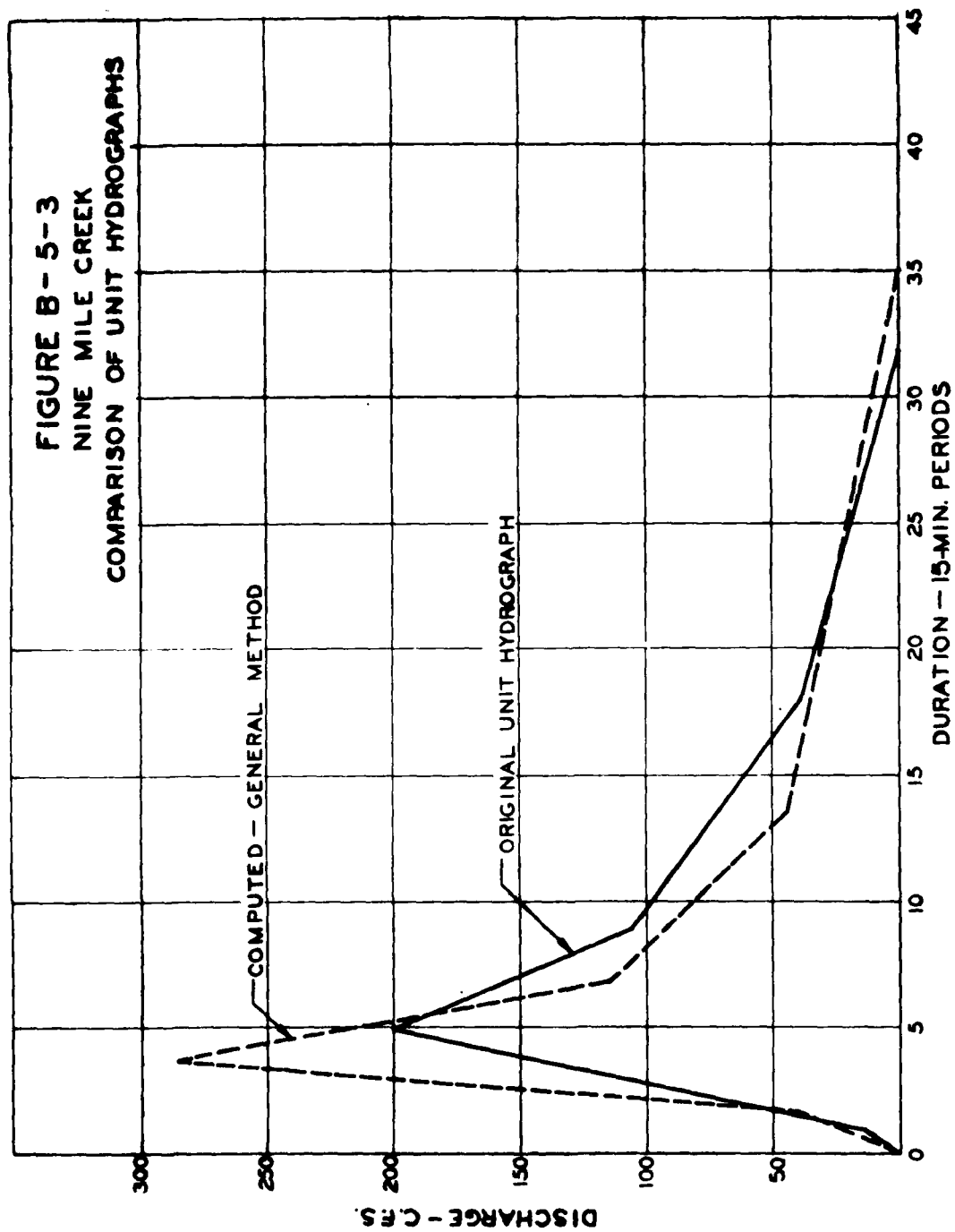
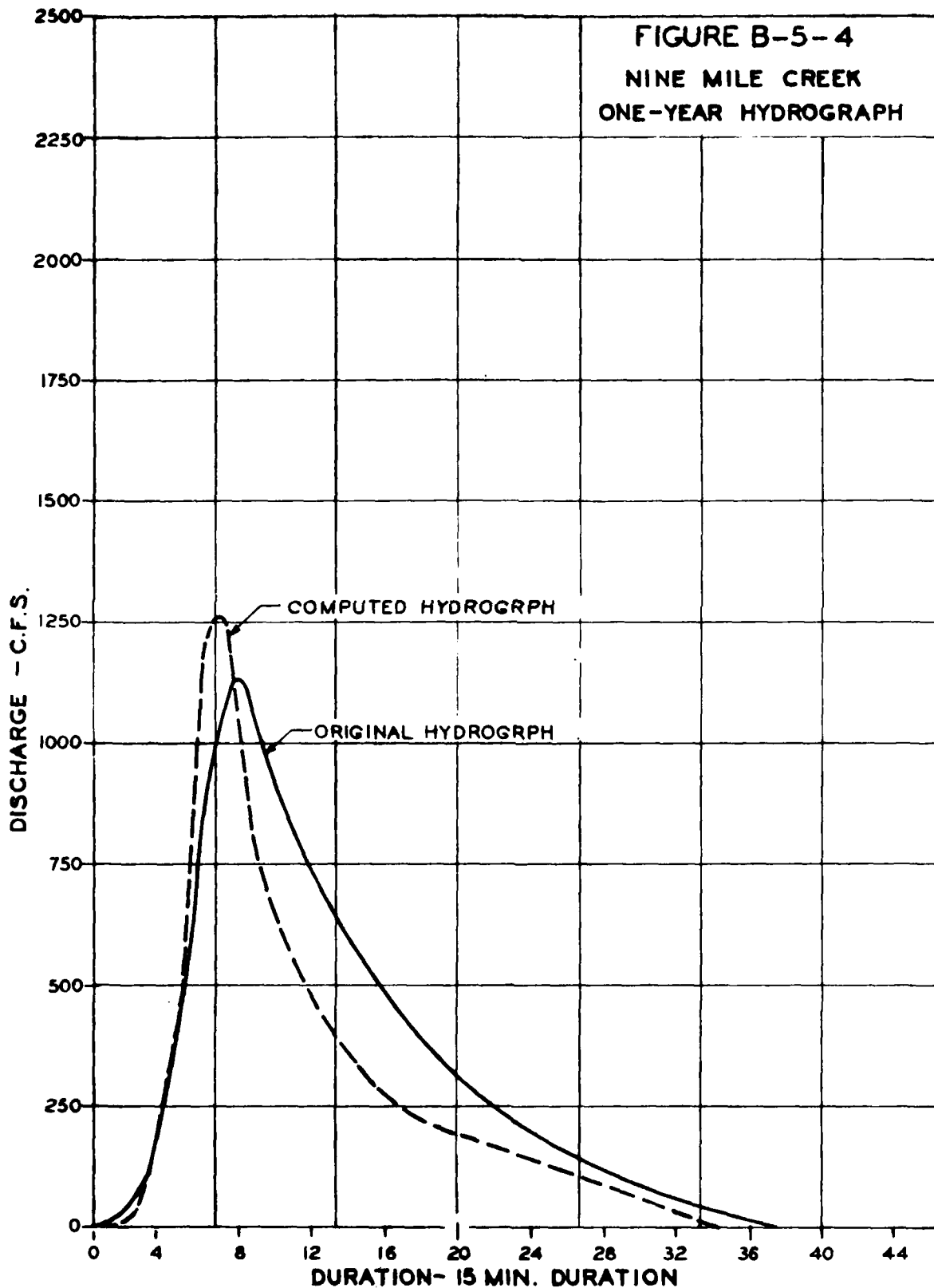


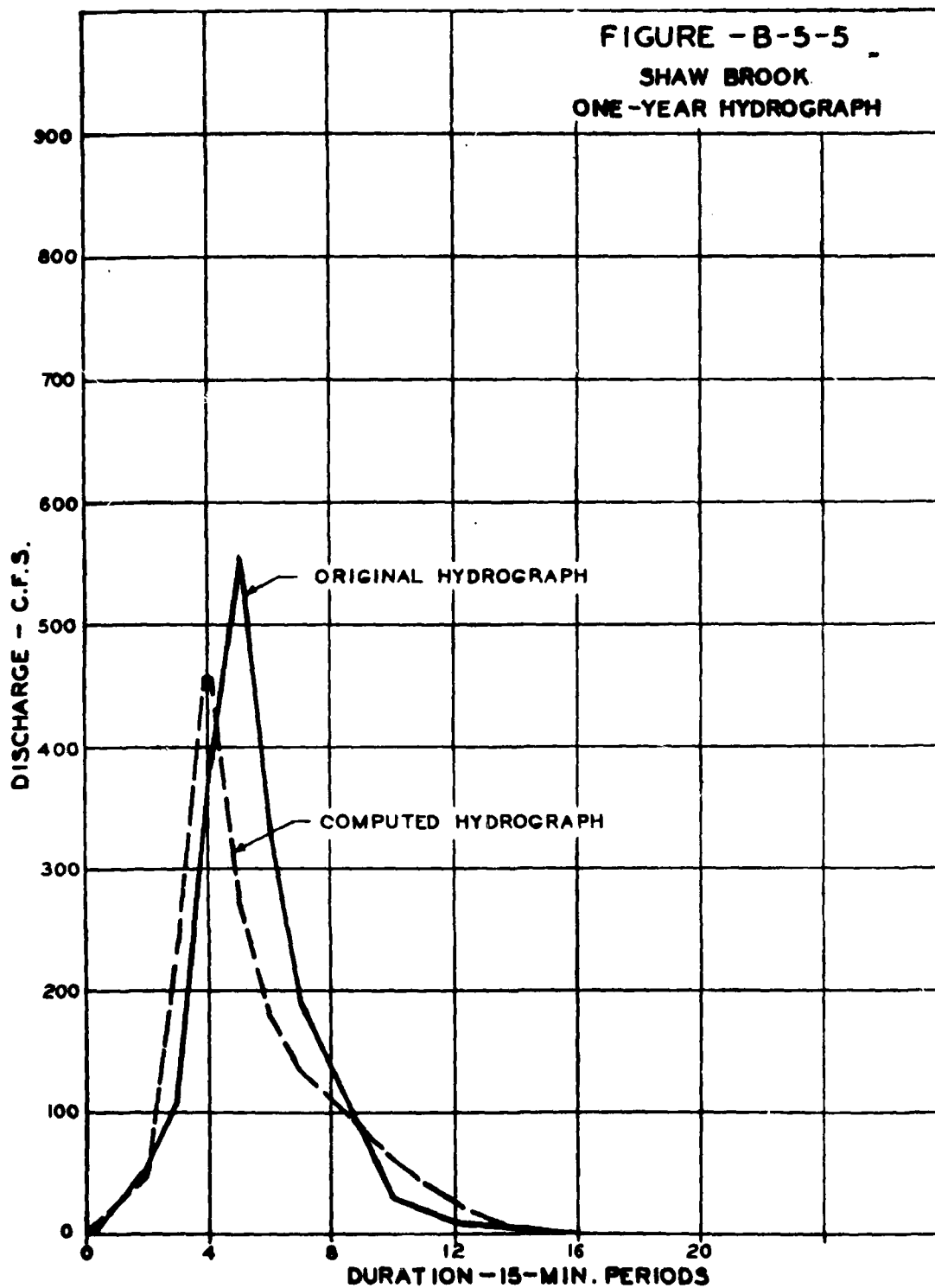
FIGURE B-5-1  
GENERAL UNIT HYDROGRAPH



**FIGURE B - 5 - 3**  
**NINE MILE CREEK**  
**COMPARISON OF UNIT HYDROGRAPHS**







## 6. Urban Stormwater Runoff

Stormwater runoff from urban areas contribute significant pollution loads to Lake Erie. In an attempt to quantify these loads, the study area drainage areas were categorized as either a combined sewer overflow or separate system to account for the higher pollution concentrations resulting from the combined sewer overflow.

Table B-6-1, lists the pollution concentrations of the combined sewer overflows.

Table B-6-2, lists the pollution concentrations of the separate system urban stormwater runoff. These concentrations vary as the percent imperviousness varies. This is due to the fact that the degree of urbanization effects the character of the stormwater runoff.

Data for Tables B-6-1 and B-6-2 came from several sources including work done in the Cleveland Area. The data on the quality of combined sewer overflow varies greatly and the data in Table B-6-1 is weighted in favor of the Cleveland data.

A search of the literature was made to provide basic data on pollution loads in stormwater. The amount of data available is not great. When data on both the concentration and flow rate were available, it was converted to a percentage of the runoff duration versus percentage of the peak concentration for that runoff. By plotting them together, an graph was developed that relates concentration to discharge which is shown on Figure B-6-1 and has been termed a pollutograph.

Using the pollutograph, peak concentrations were selected for three types of areas: rural, urban and dense urban. Averages were computed for the same areas which are shown in Table B-6-2. In reviewing the literature, several problems were encountered that would cause the data to be inconsistent. These are listed below:

1. The sampling time did not extend past the basin lag time which means most of the samples were collected before the peak discharge occurred and the lower concentration of suspended solids at the end of the runoff are not reflected.
2. The suspended solids 10-15 times the volatile suspended solids and 30-150 times the BOD concentrations indicate the suspended solids are probably inert silts.
3. Suspended solids tests were often run with a glass fiber matt and with concentrations as high as those reported the aliquots were undoubtedly very small.
4. Low BOD-COD ratios in many cases probably indicate the BOD analysis was not done with an acclimated seed.
5. No mention of preceeding storm events or time between storm events.
6. No correlation with air pollution.

Table B-6-3 summarizes the Urban Stormwater Runoff pollutant loads for the study area by decade. This data was generated using the weighted average value of the percent imperviousness of each watershed. These weighted averages are presented in Table B-6-4. The results from this procedure were about 5% less than the actual sum of the individual districts.

TABLE B-6-1

COMBINED SEWER OVERFLOW CHARACTERISTICS

Suspended Solids	200 mg/l
BOD	60 mg/l
COD	220 mg/l
Total Volatile Solids	160 mg/l
Suspended Volatile Solids	120 mg/l
Phosphorus as P	8 mg/l
Nitrogen as N	12 mg/l
Chlorides	161 mg/l

TABLE B-6-2

SEPARATE SYSTEM STORMWATER RUNOFF CHARACTERISTICS

	<u>Rural</u>	<u>Urban</u>	<u>Dense Urban</u>
Imperviousness	5%	25%	55%
Suspended Solids	200 mg/l	300 mg/l	500 mg/l
BOD	3 mg/l	20 mg/l	30 mg/l
COD	50 mg/l	150 mg/l	200 mg/l
Total Volatile Solids	35 mg/l	110 mg/l	140 mg/l
Suspended Volatile Solids	25 mg/l	80 mg/l	105 mg/l
Phosphorus as P	.2 mg/l	.7 mg/l	.5 mg/l
Nitrogen as N	2.0 mg/l	3.1 mg/l	2.2 mg/l
Chlorides	60 mg/l	160 mg/l	166 mg/l

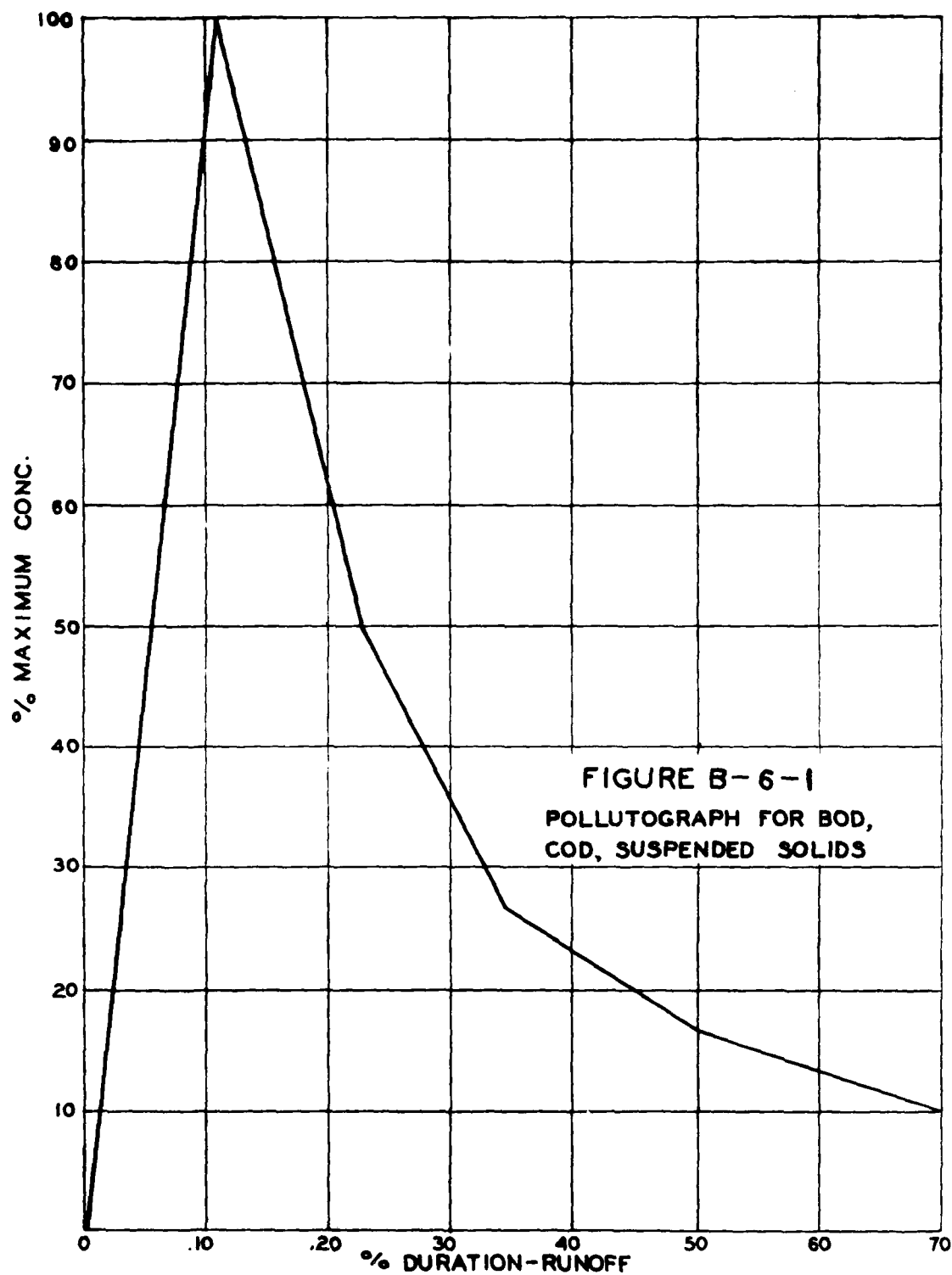


TABLE 8-6-3

## URBAN STORMWATER RUNOFF

	1970	1980	1990	2000	2010	2020
<b>Area (Acres)</b>						
Lake Erie	72,443	77,741	77,741	77,741	77,741	77,741
Cuyahoga	111,574	160,379	148,776	259,983	263,748	263,748
Rocky	28,666	36,730	41,823	41,823	94,472	94,472
Chagrin	12,140	16,880	37,890	63,140	63,140	63,140
<b>TOTAL</b>	<b>225,023</b>	<b>291,730</b>	<b>416,232</b>	<b>495,336</b>	<b>499,101</b>	<b>499,101</b>
<b>Volume (mg./Year)</b>						
Lake Erie	13,357	14,486	15,000	15,950	16,660	17,130
Cuyahoga	17,220	24,302	32,890	39,260	41,380	42,300
Rocky	3,438	4,481	4,737	12,311	13,251	13,921
Chagrin	1,440	2,050	5,560	7,850	8,350	8,720
<b>TOTAL</b>	<b>35,455</b>	<b>45,691</b>	<b>62,571</b>	<b>75,371</b>	<b>79,641</b>	<b>81,771</b>
<b>Suspended Solids (Lbs./Year)</b>						
Lake Erie	27,185,363	31,502,980	34,225,280	38,638,000	42,196,260	44,686,790
Cuyahoga	35,878,560	52,556,330	73,645,360	92,339,288	102,047,200	107,906,970
Rocky	6,918,186	10,507,947	22,087,191	28,426,851	33,895,601	36,214,311
Chagrin	2,802,790	4,198,427	9,504,400	16,956,950	19,713,240	21,912,320
<b>TOTAL</b>	<b>72,784,900</b>	<b>98,765,409</b>	<b>134,764,500</b>	<b>176,361,000</b>	<b>197,852,000</b>	<b>210,720,000</b>
<b>Biochemical Oxygen Demand (Lbs./Year)</b>						
Lake Erie	4,688,306	5,016,737	5,224,920	5,504,980	5,714,050	5,860,000
Cuyahoga	4,529,580	5,616,180	6,963,610	8,365,418	9,450,050	9,862,900
Rocky	259,089	457,638	950,375	1,397,728	1,971,048	2,218,958
Chagrin	87,530	154,340	386,780	713,630	996,110	1,226,650
<b>TOTAL</b>	<b>9,564,000</b>	<b>11,247,000</b>	<b>13,545,000</b>	<b>15,982,000</b>	<b>18,131,000</b>	<b>19,169,000</b>
<b>Chemical Oxygen Demand (Lbs./Year)</b>						
Lake Erie	20,434,397	22,729,360	23,900,970	25,598,080	26,940,020	27,867,520
Cuyahoga	22,096,920	29,603,340	36,221,140	48,685,430	55,139,350	58,141,330
Rocky	2,356,512	3,881,747	8,146,557	11,337,397	14,951,027	16,505,817
Chagrin	885,530	1,433,330	3,773,550	6,219,730	8,030,670	9,463,290
<b>TOTAL</b>	<b>45,773,000</b>	<b>57,666,000</b>	<b>74,766,000</b>	<b>91,841,000</b>	<b>105,041,000</b>	<b>111,978,000</b>
<b>Total Volatile Solids (Lbs./Year)</b>						
Lake Erie	14,885,383	16,571,547	17,374,560	18,550,760	19,474,370	20,109,830
Cuyahoga	16,076,630	21,544,127	26,575,880	35,533,003	40,321,980	42,488,370
Rocky	1,694,852	2,616,107	5,911,000	8,245,000	10,936,000	12,094,000
Chagrin	634,000	1,034,000	3,509,000	4,501,000	5,834,000	6,916,000
<b>TOTAL</b>	<b>33,291,000</b>	<b>41,971,000</b>	<b>54,373,000</b>	<b>66,830,000</b>	<b>76,566,000</b>	<b>81,608,000</b>
<b>Suspended Volatile Solids (Lbs./Year)</b>						
Lake Erie	11,057,000	12,292,000	12,969,000	13,796,000	14,496,000	14,980,000
Cuyahoga	11,877,000	15,865,000	20,983,000	26,056,000	29,565,000	31,178,000
Rocky	1,225,000	2,040,000	4,279,000	5,979,000	7,947,000	8,795,000
Chagrin	457,000	747,000	1,814,000	3,257,000	4,231,000	5,023,000
<b>TOTAL</b>	<b>24,616,000</b>	<b>30,944,000</b>	<b>39,985,000</b>	<b>49,088,000</b>	<b>56,239,000</b>	<b>59,976,000</b>
<b>Phosphorus as P (Lbs./Year)</b>						
Lake Erie	546,000	556,000	568,000	571,000	573,000	575,000
Cuyahoga	684,000	549,000	614,000	678,000	730,000	740,000
Rocky	13,000	20,000	34,000	34,000	72,000	79,000
Chagrin	4,000	6,000	15,000	28,000	37,000	44,000
<b>TOTAL</b>	<b>1,047,000</b>	<b>1,131,000</b>	<b>1,236,000</b>	<b>1,331,000</b>	<b>1,412,000</b>	<b>1,438,000</b>

URBAN STORMWATER RUNOFF (Cont'd.)

	1970	1980	1990	2000	2010	2020
Nitrogen as N (Lbs./Year)						
Lake Erie	912,000	948,000	967,000	982,000	993,000	999,000
Cuyahoga	897,000	1,101,000	1,331,000	1,538,000	1,658,000	1,689,000
Rocky	70,000	105,000	216,000	276,000	328,000	349,000
Chagrin	27,000	31,000	95,000	163,000	189,000	210,000
TOTAL	1,906,000	2,195,000	2,609,000	2,959,000	3,168,000	3,247,000
Chlorides (Lbs./Year)						
Lake Erie	17,129,000	19,441,000	20,164,000	21,635,000	22,388,000	23,024,000
Cuyahoga	19,806,000	27,645,000	37,818,000	47,693,000	54,176,000	56,808,000
Rocky	2,630,000	4,295,000	9,033,000	12,402,000	16,126,000	17,728,000
Chagrin	1,008,000	1,612,000	3,880,000	6,904,000	8,753,000	10,250,000
TOTAL	40,573,000	52,993,000	70,895,000	88,434,000	101,443,000	107,808,000

TABLE B-6-4

PERCENT IMPERVIOUSNESS  
(Weighted Average)

	1970	1980	1990	2000	2010	2020
Chargin River Watershed						
Separate Systems	6	7	10	14	18	21
Combined Systems	-	-	-	-	-	-
Rocky River Watershed						
Separate Systems	7	9	13	17	22	24
Combined Systems	25	30	30	30	30	30
Cuyahoga River Watershed						
Separate Systems	10	13	17	21	24	26
Combined Systems	38	41	43	45	47	47
Lake Erie Watershed						
Separate Systems	20	26	30	34	37	39
Combined Systems	46	46	47	47	47	47

## 7. Rural Stormwater Runoff

Although the stormwater runoff pollution loads from a rural area are low as compared to an urban area of equal size, the total load from rural land in the study is significant due to the large amount of land in the category. Table B-7-1 shows land usage for the study area.

Table B-7-2 shows the concentrations of the waste constituents used for rural stormwater runoff. It is noted that these are the same as urban stormwater runoff of low percent imperviousness.

Table B-7-3 summarizes the annual rural stormwater pollution loads by decade for each of the watersheds in the study area.

TABLE B-7-1

RURAL AND URBAN AREAS

	<u>1970</u>	<u>1980</u>	<u>ACRES</u> <u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
CUYAHOGA RIVER WATERSHED						
Urban	111,600	160,400	218,800	260,000	263,800	263,800
Developable Rural*	152,200	103,400	45,000	3,800	0	0
Rural	256,600	256,600	256,600	256,600	256,600	256,600
ROCKY RIVER WATERSHED						
Urban	28,700	38,700	81,800	94,500	94,500	94,500
Developable Rural	65,800	55,700	12,700	0	0	0
Rural	93,700	93,700	93,700	93,700	93,700	93,700
CHAGRIN RIVER WATERSHED						
Urban	12,300	16,900	37,900	63,100	63,100	63,100
Developable Rural	50,800	46,300	25,200	0	0	0
Rural	107,600	107,600	107,600	107,600	107,600	107,600
LAKE ERIE						
Urban	72,400	77,700	77,700	77,700	77,700	77,700
Developable Rural	5,300	0	0	0	0	0
Rural	7,400	7,400	7,400	7,400	7,400	7,400

\*Developable urban is defined as that land which is rural but will be developed into an urban area, according to the land use maps, by 2020.

TABLE B-7-2

RURAL STORMWATER RUNOFF

Suspended Solids	200 mg/l
B.O.D.	3 mg/l
C.O.D.	50 mg/l
Total Volatile Solids	35 mg/l
Suspended Volatile Solids	25 mg/l
Phosphorus as P	.2 mg/l
Nitrogen as N	2.0 mg/l
Chlorides	60 mg/l

TABLE B-7-3  
RURAL STORMWATER RUNOFF

	1970	1980	1990	2000	2010	2020
<b>Area (Acres)</b>						
Lake Erie	12,700	7,400	7,400	7,400	7,400	7,400
Cuyahoga	408,800	360,000	301,600	260,400	256,600	256,600
Rocky	159,500	149,400	106,400	93,700	93,700	93,700
Chagrin	158,400	153,900	132,800	107,600	107,600	107,600
<b>TOTAL</b>	<b>739,400</b>	<b>670,700</b>	<b>548,200</b>	<b>464,100</b>	<b>465,300</b>	<b>465,300</b>
<b>Volume (Mill. Gal./Year)</b>						
Lake Erie	1,368	785	785	785	785	785
Cuyahoga	43,500	38,316	32,090	27,710	27,310	27,310
Rocky	16,970	15,900	11,310	9,970	9,970	9,970
Chagrin	16,890	16,370	12,130	11,450	11,450	11,450
<b>TOTAL</b>	<b>78,668</b>	<b>71,365</b>	<b>58,315</b>	<b>49,915</b>	<b>49,515</b>	<b>49,515</b>
<b>Suspended Solids (1,000 Lbs./Year)</b>						
Lake Erie	2,307	1,343	1,343	1,343	1,343	1,343
Cuyahoga	74,373	65,314	54,867	47,388	46,703	46,703
Rocky	29,021	27,193	19,331	17,049	17,049	17,049
Chagrin	28,830	28,003	22,180	19,585	19,585	19,585
<b>TOTAL</b>	<b>134,531</b>	<b>122,053</b>	<b>99,741</b>	<b>85,365</b>	<b>84,680</b>	<b>84,680</b>
<b>Biochemical Oxygen Demand (1,000 Lbs./Year)</b>						
Lake Erie	36	21	21	21	21	21
Cuyahoga	1,179	1,038	870	751	740	740
Rocky	460	431	306	270	270	270
Chagrin	457	443	383	310	310	310
<b>TOTAL</b>	<b>2,132</b>	<b>1,933</b>	<b>1,580</b>	<b>1,352</b>	<b>1,341</b>	<b>1,341</b>
<b>Chemical Oxygen Demand (1,000 Lbs./Year)</b>						
Lake Erie	563	328	328	328	328	328
Cuyahoga	18,145	15,979	13,387	11,558	11,391	11,391
Rocky	7,078	6,532	4,719	4,158	4,158	4,158
Chagrin	7,032	6,830	5,897	4,777	4,777	4,777
<b>TOTAL</b>	<b>32,818</b>	<b>29,769</b>	<b>24,331</b>	<b>20,821</b>	<b>20,654</b>	<b>20,654</b>
<b>Total Volatile Solids (1,000 Lbs./Year)</b>						
Lake Erie	384	229	229	229	229	229
Cuyahoga	12,702	11,186	9,371	8,091	7,974	7,974
Rocky	4,954	4,642	3,303	2,910	2,910	2,910
Chagrin	4,922	4,781	4,129	3,344	3,344	3,344
<b>TOTAL</b>	<b>22,972</b>	<b>20,838</b>	<b>17,032</b>	<b>14,574</b>	<b>14,457</b>	<b>14,457</b>
<b>Suspended Volatile Solids (1,000 Lbs./Year)</b>						
Lake Erie	282	164	164	164	164	164
Cuyahoga	9,073	7,990	6,692	5,780	5,696	5,696
Rocky	3,539	3,316	2,360	2,079	2,079	2,079
Chagrin	3,515	3,415	2,948	2,388	2,388	2,388
<b>TOTAL</b>	<b>16,409</b>	<b>14,885</b>	<b>12,166</b>	<b>10,411</b>	<b>10,327</b>	<b>10,327</b>
<b>Phosphorus as P (1,000 Lbs./Year)</b>						
Lake Erie	2	1	1	1	1	1
Cuyahoga	73	64	54	47	46	46
Rocky	29	27	19	17	17	17
Chagrin	28	27	23	19	19	19
<b>TOTAL</b>	<b>132</b>	<b>119</b>	<b>97</b>	<b>84</b>	<b>83</b>	<b>83</b>

RURAL STORMWATER RUNOFF (Cont'd.)

	1970	1980	1990	2000	2010	2020
<b>Nitrogen as N</b>						
(1,000 Lbs./Year)						
Lake Erie	22	13	13	13	13	13
Cuyahoga	726	640	536	463	456	456
Rocky	283	265	188	166	166	166
Chagrin	<u>281</u>	<u>272</u>	<u>236</u>	<u>191</u>	<u>191</u>	<u>191</u>
TOTAL	1,312	1,191	973	833	826	826
<b>Chlorides</b>						
(1,000 Lbs./Year)						
Lake Erie	675	393	393	393	393	393
Cuyahoga	21,774	19,175	16,064	13,870	13,669	13,669
Rocky	8,494	7,959	5,664	4,990	4,990	4,990
Chagrin	<u>8,438</u>	<u>8,196</u>	<u>7,071</u>	<u>5,732</u>	<u>5,732</u>	<u>5,732</u>
TOTAL	39,381	35,723	29,198	24,985	24,784	24,784

APPENDIX A  
SELECTION OF DESIGN STORM

The magnitude of the design storm that a given facility must treat obviously affects both the storage and treatment cost. In the feasibility study a one year design storm was chosen, since that is the design currently being used for all of design work in the Cleveland area at this time. It is the purpose of this portion of the Survey Scope study to review this decision and compare designs of 6 months, 1, 3, 5 and 10 years.

The question to answer is - what is the economic and environmental impact of having a storm greater than the design storm occur? In order to compare volumes of runoff treated under certain design conditions, Table 1 was prepared to show the ratios, of the runoff from a 6 month, 1, 3, 5 or 10 year rainfall to the capacity of a storage treatment facility of various design sizes. Each design situation has a ratio of 1.00 when the frequency of a storm matches the design storm chosen to compute the volume of the storage basin.

To further compare these volumes, Table 2 has been prepared to show the efficiency of stormwater collection and treatment for various storms with different designs. Table 2 shows the percentage of total annual runoff time when the storage and treatment capacity is exceeded by a runoff resulting from a storm with a frequency greater than that used for the design. Figure 1 shows the reverse, that is, the percentage of total annual volume treated under the different storm occurrences and design schemes. It is important to note that the capacity is exceeded at the later part of a storm runoff occurrence and after the high concentrations that are normally associated with the first flush have occurred. Further, it should be noted these percentages will only occur once in the period of frequency. For example, if the facility is designed for the one year storm and a rainfall equal to the 10 year occurrence happens, then from Figure 1, 90% of the total annual volume would be treated. The other 10% would receive treatment, but the capacity of the facility would be exceeded hydraulically

and the degree of treatment would be reduced. Again this would only occur once in 10 years. However, within a 10 year period several rainfalls may occur which would exceed the one year frequency used for design, such as the 5 year, 3 year, 2 year, etc. To illustrate this, a period of record was chosen arbitrarily from 1950 to 1967, and a detailed analysis of the rainfall data was done. The results are shown in Table 3.

From Table 3, it can be shown that in a 16 year period only 2.7% of the runoff exceeded the design value. This is equivalent to 1.7% in a 10 year period of all accumulated runoff exceeding the 1 year runoff.

Costs were computed on typical areas for storage and treatment facilities with various design storm criteria. These costs were reduced to a cost per acre value and compared to the suspended solids removal achieved. This data is shown on Figure 2. Three treatment schemes were considered:

Scheme A would be the situation where land is available for earth storage lagoons.

Scheme B would be the situation when land is expensive and not available in tracts large enough for Scheme A. Storage would be in concrete storage tanks.

Scheme C would be the situation when no land is available for storage and treatment would have to be designed for the peak flow without storage.

Figure 3 compares the percent removal to cost per acre and cost per percent removal. The treatment technique for the three schemes in Figure 2 and Figure 3 is screening followed by sedimentation, microstraining and ozonation. The detention time in the sedimentation basin is two days. A polymer would be used to hasten sedimentation also. Figure 4 compares the percentage increase in cost to percentage increase in treatment.

Using this data, the design storm for the storage and treatment was

selected. The criteria for the collection system is governed by drainage and flooding constraints rather than pollution constraints. Generally, the collection systems were designed to handle a 5 to 10 year storm consistent with the usual engineering practices.

Referring to these graphs, it can be seen that for a storm water treatment design greater than one year the cost start to rise sharply. The 3, 5 and 10 year designs cost substantially more than the 6 month or 1 year; consequently the choice was then reduced to either the 6 month or 1 year design. When the actual rainfall data is reviewed in Table 3, it shows that the 6 month storm was exceeded 35 times in the 16.5 year period. If the one year design storm is compared to the actual data, it is noted to have been exceeded 17 times. Likewise, the 3 year storm was exceeded 5 times. Statistically, this is expected.

Again referring to Figure 4, it is seen that the cost to increase from a 6 month design to a one year design is about 11% for Scheme A which is the most commonly encountered scheme. This same increase also reduces the number of times the facility design is exceeded by fifty percent. Further, using the one year design will provide greater margin for the inevitable inconsistencies in rainfall occurrences.

After considering these facts, the 1 year design storm was selected for the survey scope study.

TABLE 1

Frequency of a Given Storm	Ratio of Runoff From Given Storm to Capacity Provided by a Design Storm of:				
	<u>6 Month Design</u>	<u>1 Year Design</u>	<u>3 Year Design</u>	<u>5 Year Design</u>	<u>10 Year Design</u>
6 Months	1.00	0.68	0.42	0.36	0.25
1 Year	1.47	1.00	0.62	0.52	0.36
3 Years	2.38	1.62	1.00	0.85	0.58
5 Years	2.82	1.92	1.18	1.00	0.69
10 Years	4.06	2.76	1.72	1.45	1.00

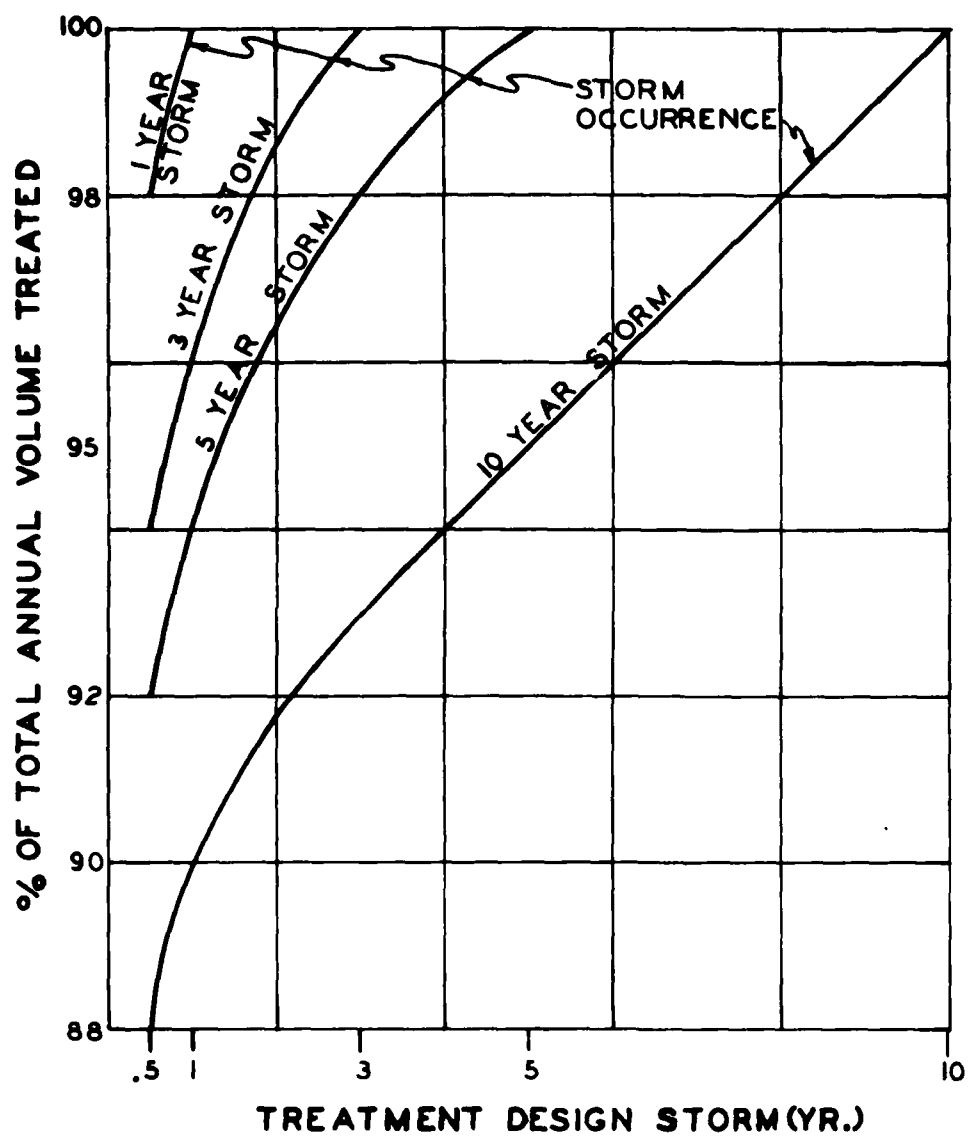
TABLE 2

Frequency of a Given Storm	Percentage of Total Annual Runoff Time When Treatment Capacity is Exceeded by Runoff From Storm of Given Frequency				
	<u>6 Month Design</u>	<u>1 Year Design</u>	<u>3 Year Design</u>	<u>5 Year Design</u>	<u>10 Year Design</u>
6 Months	0	0	0	0	0
1 Year	2%	0	0	0	0
3 Years	6%	4%	0	0	0
5 Years	8%	6%	2%	0	0
10 Years	12%	10%	7%	5%	0

TABLE 3

AMOUNT OF RUNOFF EXCEEDING STORAGE CAPACITY OF  
VARIOUS DESIGN STORM FREQUENCIES OVER THE PERIOD 1950-1967

(1) Design Storm	(2) Number of Rainfall Events Exceeding the Design Storm In the Period	(3) Total Rainfall Depth Resulting From These Events	(4) Total Runoff Resulting From These Events	(5) Total Runoff From All Events During Period	(4/5) Total Runoff Exceeding Design Storm Total Runoff in 16 Years
6 mo.	35	15.05	5.57	126.5	4.4%
1 yr.	17	7.80	3.42	126.5	2.7%
3 yr.	5	3.20	1.63	126.5	1.3%
5 yr.	3	2.40	1.27	126.5	1.0%
10 yr.	1	1.12	0.66	126.5	0.5%



EXAMPLE: 5 YEAR STORM  
& 1 YEAR STORM FACILITY  
RESULT: 94% OF TOTAL  
ANNUAL VOLUME TREATED

FIG. 1

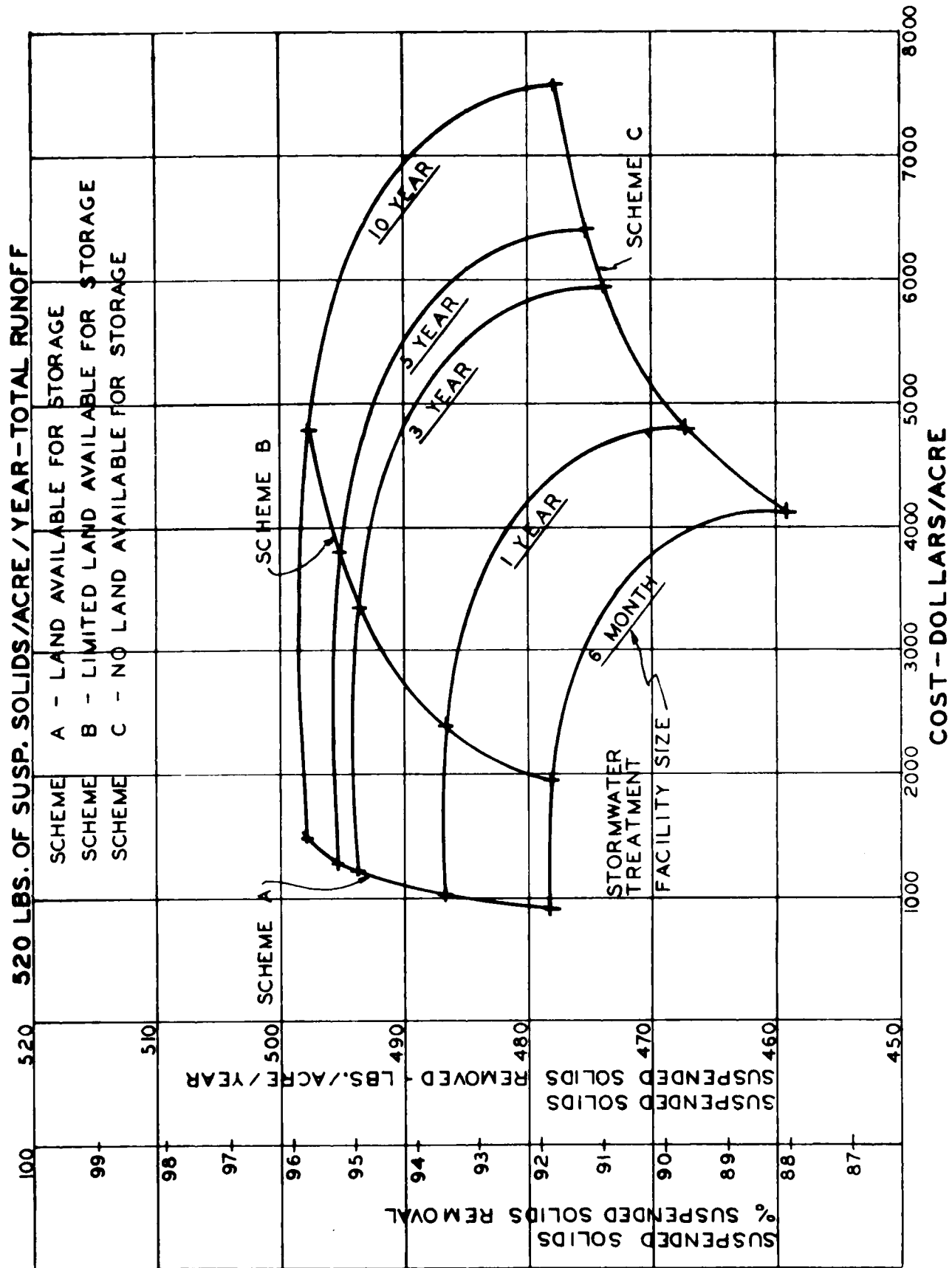


FIG. 2

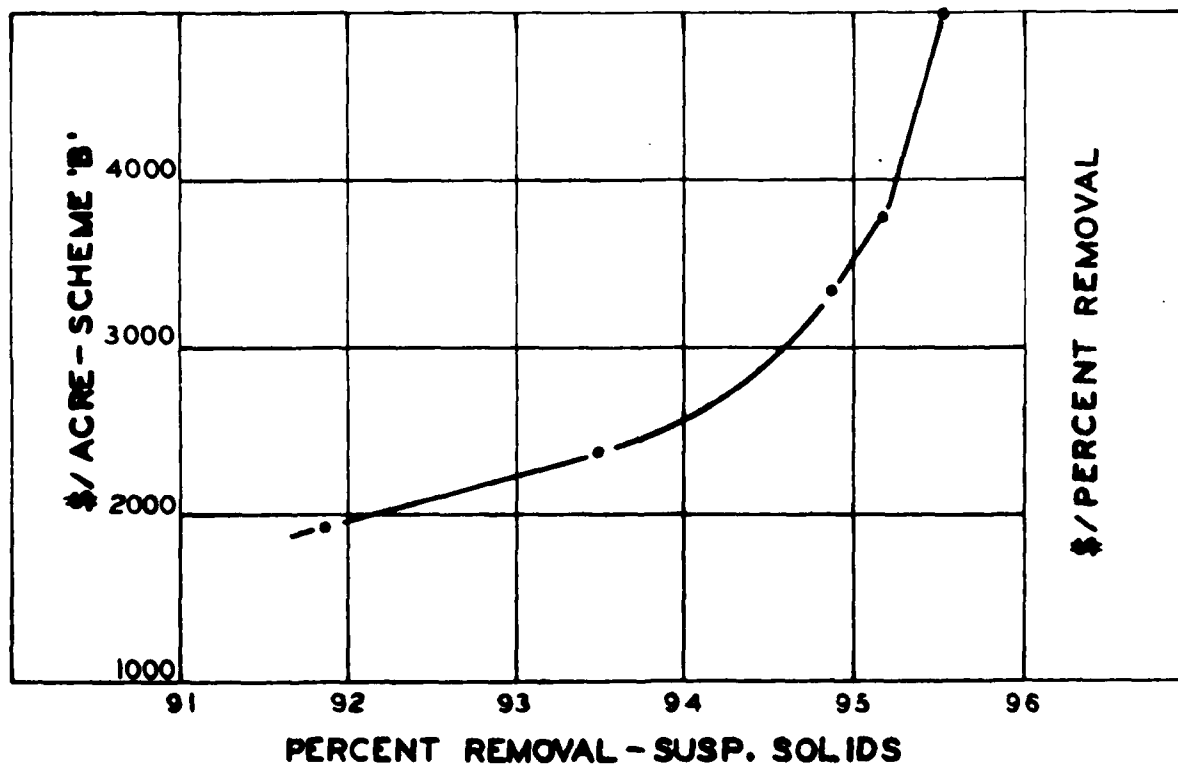
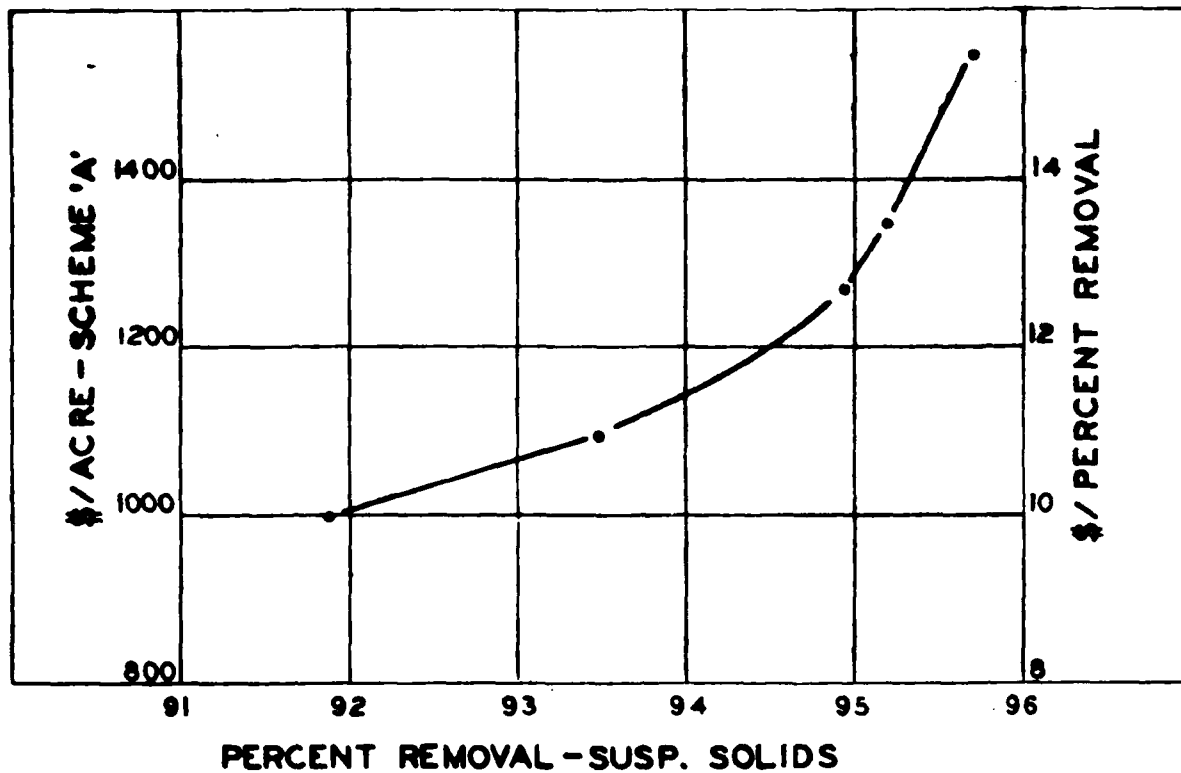


FIG. 3

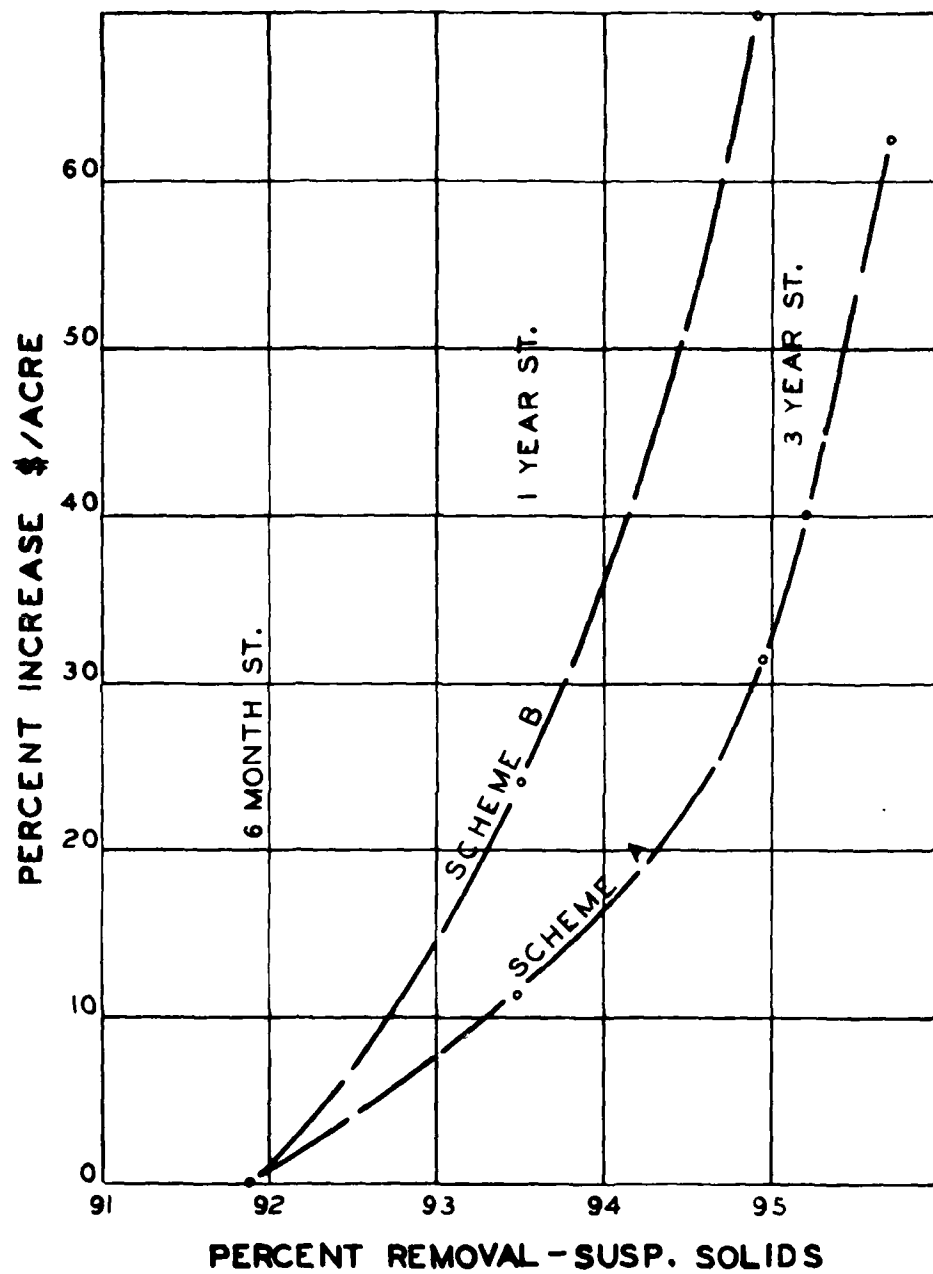


FIG. 4

APPENDIX B

DRAINAGE AREAS CHARACTERISTICS

ROCKY RIVER WATERSHED

<u>Area Designation</u>	<u>Total Area (Acres)</u>	<u>Open Space Area (Acres)</u>	<u>% Area to be Developed</u>	<u>Length of Channel (Ft.)</u>	<u>Channel Slope Ft./Mile</u>
R-1	716	0	100	(4,500)	23.46
R-2	3,994	0	100	20,000	13.20
R-3	2,112	0	100	21,000	27.65
R-4	845	0	100	(4,500)	58.66
R-5	872	0	100	4,000	92.4
R-6	3,434	0	100	17,000	18.63
R-7	2,222	0	100	15,000	24.64
R-8	2,544	0	100	8,000	33.0
R-9	266	0	100	4,000	26.40
R-10	6,437	275	96	30,000	31.68
R-11	3,921	0	100	30,000	10.56
R-12	7,484	0	100	40,000	48.84
R-13	7,466	368	96	40,000	46.20
R-14	1,120	0	100	12,000	61.6
R-15	918	0	100	8,000	79.20
R-16	2,213	0	100	15,000	116.16
R-17	1,285	0	100	11,000	148.80
R-18	3,471	0	100	22,000	33.60
R-19	3,177	0	100	15,000	8.80
R-20	4,187	0	100	11,000	52.80
R-21	532	0	100	9,000	76.26
R-22	2,185	321	86	18,000	85.06
R-23	5,197	0	100	26,000	57.87
R-24	3,140	184	95	26,000	56.86

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

ROCKY RIVER WATERSHED

<u>Area Designation</u>	<u>Total Area (Acres)</u>	<u>Open Space Area (Acres)</u>	<u>% Area to be Developed</u>	<u>Length of Channel (Ft.)</u>	<u>Channel Slope Ft./Mile</u>
R-25	3,155	0	100	27,000	70.40
R-26	762	0	100	7,000	52.80
R-27	2,480	0	100	28,000	60.34
R-28	8,145	0	100	30,000	18.48
R-29	2,553	0	100	14,000	113.14
R-30	1,423	0	100	15,000	65.12
R-31	780	0	100	15,000	52.80
R-32	313	275	92	22,000	38.40
R-33	799	0	100	6,000	158.40
R-34	1,588	0	100	22,000	33.60
R-35	2,736	0	100	18,000	29.33

LAKE ERIE WATERSHED

LE-1	4,362	0	100	20,600	30.75
LE-2	3,232	130	96	6,600	49.60
LE-3	5,758	280	95	7,400	0
LE-4	15,444	1,080	93	55,800	55.35
LE-5	23,396	0	92	41,200	59.59
LE-6	4,980	0	92	10,000	0
LE-7	3,958	0	100	8,600	0
LE-8	2,800	0	100	7,500	0
LE-9	3,398	0	100	12,000	52.8
LE-10	5,115	0	100	23,000	34.43
LE-11	5,298	0	100	33,000	17.6

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CUYAHOGA RIVER WATERSHED

<u>Area Designation</u>	<u>Total Area (Acres)</u>	<u>Open Space Area (Acres)</u>	<u>% Area to be Developed</u>	<u>Length of Channel (Ft.)</u>	<u>Channel Slope Ft./Mile</u>
CU-1	2,472	0	100	12,000	30.80
CU-2	4,684	0	100	36,000	77.73
CU-3	3,562	0	100	21,000	82.97
CU-4	23,770	0	100	76,000	37.51
CU-5	12,654	0	100	52,000	51.78
CU-6	3,995	138	97	26,000	38.58
CU-7	4,527	872	81	34,000	43.48
CU-8	8,870	780	92	42,000	72.91
CU-9	1,698	643	63	8,000	191.4
CU-10	1,846	460	76	10,000	147.84
CU-11	2,370	184	93	14,000	82.97
CU-12	340	0	100	7,000	75.42
CU-13	4,500	0	100	28,000	41.48
CU-14	3,425	698	80	18,000	152.53
CU-15	652	184	72	7,000	98.05
CU-16	1,791	165	91	14,000	82.97
CU-17	1,368	0	100	5,000	78.20
CU-18	551	0	100	4,000	26.4
CU-19	5,730	0	100	23,000	73.46
CU-20	1,515	0	100	15,000	95.04
CU-21	2,057	450	79	14,500	196.63
CU-22	1,386	643	54	12,000	171.60
CU-23	1,240	0	100	3,000	35.2
CU-24	3,388	0	100	17,000	62.1
CU-25	4,472	0	100	23,000	18.36

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CUYAHOGA RIVER WATERSHED

<u>Area Designation</u>	<u>Total Area (Acres)</u>	<u>Open Space Area (Acres)</u>	<u>% Area to be Developed</u>	<u>Length of Channel (Ft.)</u>	<u>Channel Slope Ft./Mile</u>
CU-26	1,221	0	100	10,000	58.00
CU-27	2,874	0	100	6,000	112.20
CU-28	1,634	0	100	11,000	72.0
CU-29	5,914	1,534	75	24,000	11.00
CU-30	1,974	0	100	11,000	52.80
CU-31	1,586	184	89	15,000	56.32
CU-32	2,020	0	100	14,000	128.22
CU-33	1,230	0	100	8,500	62.11
CU-34	2,507	0	100	11,000	12.00
CU-35	11,175	2,507	78	39,000	13.53
CU-36	3,186	0	100	6,000	79.20
CU-37	3,039	0	100	9,000	70.40
CU-38	2,121	0	100	8,500	99.38
CU-39	3,884	0	100	16,000	49.50
CU-40	863	184	79	11,000	120.00
CU-41	1,130	285	75	11,000	153.60
CU-42	1,625	0	100	13,000	77.16
CU-43	3,765	2,635	30	11,400	34.7
CU-44	3,094	464	85	18,000	10.6
CU-45	3,976	0	100	21,000	28.9
CU-46	1,616	0	100	20,400	47.9
CU-47	7,833	1,560	80	38,000	49.3
CU-48	1,625	0	100	10,000	66.0
CU-49	1,304	130	90	8,400	69.1
CU-50	8,228	0	100	35,700	16.3

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CUYAHOGA RIVER WATERSHED

<u>Area Designation</u>	<u>Total Area (Acres)</u>	<u>Open Space Area (Acres)</u>	<u>% Area to be Developed</u>	<u>Length of Channel (Ft.)</u>	<u>Channel Slope Ft./Mile</u>
CU-51	5,492	1,100	80	16,800	25.1
CU-52	1,882	94	95	12,600	3.4
CU-53	3,719	0	100	21,000	17.6
CU-54	3,526	350	90	13,200	52.80
CU-55	1,900	0	100	15,000	7.0
CU-56	2,800	0	100	15,000	17.6
CU-57	1,965	200	90	8,000	69.3
CU-58	7,906	474	94	30,200	25.4
CU-59	2,249	0	100	10,000	63.4
CU-60	2,534	0	100	2,000	158.4
CU-61	3,223	0	100	6,000	88
CU-62	3,150	0	100	23,000	50.5
CU-63	1,423	0	100	11,200	4.7
CU-64	3,324	0	100	8,000	33
CU-65	661	0	100	6,000	114.4
CU-66	3,085	0	100	11,800	53.7
CU-67	2,608	0	100	20,000	22.5
CU-68	1,905	0	100	9,000	70.4
CU-69	1,914	570	70	6,000	17.6
CU-70	6,327	0	100	29,000	24.6
CU-71	2,681	0	100	16,200	29.3
CU-73	1,056	0	100	10,000	79.20
CU-74	1,864	642	66	15,000	49.28
CU-75	2,663	321	88	18,000	23.46

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CUYAHOGA RIVER WATERSHED

<u>Area Designation</u>	<u>Total Area (Acres)</u>	<u>Open Space Area (Acres)</u>	<u>% Area to be Developed</u>	<u>Length of Channel (Ft.)</u>	<u>Channel Slope Ft./Mile</u>
CU-76	872	137	85	9,000	52.8
CU-77	2,000	367	82	12,000	57.20
CU-78	3,250	734	78	23,000	34.43
CU-79	1,360	275	80	8,000	79.2
CU-81	486	0	100	5,000	42.24
CU-82	551	0	100	3,000	158.4
CU-83	835	0	100	5,000	95.5
CU-84	677	0	100	4,000	238

CHAGRIN RIVER WATERSHED

CHN-1	2,070	550	74	13,000	20
CHN-2	7,140	1,100	85	29,000	21.8
CHN-3	3,310	370	89	26,000	44.7
CHN-4	1,360	230	84	16,000	135.3
CHN-5	2,460	830	67	16,000	135.3
CHN-6	2,440	0	100	22,000	103.2
CHN-7	690	140	80	6,000	255.2
CHN-8	1,110	0	100	6,000	264.0
CHN-9	1,440	500	66	14,000	98.0
CHN-10	3,130	780	76	13,000	138.1
CHN-11	3,750	1,700	55	15,000	140.8
CHN-12	1,590	410	75	11,000	67.2
CHN-13	2,440	690	72	13,000	97.47
CHN-16	1,600	0	100	10,000	58.1
CHN-17	1,330	0	100	13,000	60.9

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CHAGRIN RIVER WATERSHED

<u>Area Designation</u>	<u>Total Area (Acres)</u>	<u>Open Space Area (Acres)</u>	<u>% Area to be Developed</u>	<u>Length of Channel (Ft.)</u>	<u>Channel Slope Ft./Mile</u>
CHN-18	640	0	100	4,500	152.5
CHN-19	710	0	100	5,000	95.0
CHN-20	690	230	67	7,000	113.1
CHN-21	460	0	100	4,000	171.6
CHN-22	740	50	92	6,500	146.2
CHN-23	1,230	0	100	6,000	184.8
CHN-24	2,760	0	100	17,000	40.4
CHN-25	2,400	640	74	15,000	70.4
CHN-26	1,910	370	81	14,000	113.1
CHN-27	2,670	320	89	12,000	105.6
CHN-28	2,150	0	100	14,000	83.0
CHN-29	660	0	100	8,000	66.0
CHN-30	1,070	0	100	5,000	116.2
CHN-31	1,580	340	79	13,000	40.6
CHN-32	890	0	100	3,000	88.0
CHN-33	910	0	100	6,000	70.40
CHN-34	770	0	100	10,000	37.0
CHN-35	1,340	447	67	16,000	13.2
CHN-36	2,520	840	67	10,000	26.8

APPENDIX C

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

ROCKY RIVER WATERSHED

<u>Area Designation</u>	<u>Area (Acres)</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>*</u>
R-1	716	40	45	45	45	45	45	2
R-2	3,994	10	15	20	25	30	30	2
R-3	2,112	25	28	30	32	35	35	2
R-4	845	40	45	45	45	45	45	2
R-5	872	30	35	40	45	45	45	2
R-6	3,434	10	15	20	25	30	30	3
R-7	2,222	<10	10	15	20	25	25	3
R-8	2,544	15	18	20	25	30	30	2
R-9	266	25	30	30	30	30	30	1
R-10	6,437	12	15	17	20	25	28	2
R-11	3,921	<10	<10	10	12	15	20	3
R-12	7,484	<10	<10	10	15	20	25	3
R-13	7,466	10	15	20	25	30	30	3
R-14	1,120	<10	<10	10	15	20	25	3
R-15	918	<10	<10	10	15	20	25	3
R-16	2,213	<10	14	17	20	25	25	3
R-17	1,285	<10	14	17	20	25	25	3
R-18	3,471	<10	<10	10	15	20	25	3
R-19	3,177	<10	<10	<10	10	15	18	3
R-20	4,187	<10	<10	10	12	15	20	3
R-21	532	<10	<10	10	15	20	25	2
R-22	2,185	<10	<10	10	15	20	25	3

\*Note: 1 = Combined  
2 = Separate  
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

ROCKY RIVER WATERSHED

<u>Area Designation</u>	<u>Area (Acres)</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>*</u>
R-23	5,197	<10	<10	10	15	17	20	3
R-24	3,140	<10	<10	10	15	20	25	3
R-25	3,155	<10	<10	<10	10	15	18	3
R-26	762	<10	<10	<10	10	12	15	3
R-27	2,480	<10	<10	10	15	17	20	3
R-28	8,145	<10	<10	10	15	20	25	3
R-29	2,553	<10	<10	<10	10	12	15	3
R-30	1,423	<10	<10	<10	10	12	15	3
R-31	780	<10	<10	<10	10	15	20	3
R-32	313	<10	<10	10	15	20	22	3
R-33	799	<10	<10	<10	10	12	15	3
R-34	1,588	<10	10	15	20	22	25	2
R-35	2,736	<10	10	15	20	22	25	2
Total	94,472 Acres 147.61 Sq. Mile							
Average Area	2,700 Acres							

LAKE ERIE WATERSHED

LE-1	4,362	27	30	35	40	45	45	2
LE-2	3,232	30	35	40	45	45	45	2
LE-3	5,758	30	35	40	45	45	45	2
LE-4	15,444	17	25	30	35	40	45	3
LE-5	23,396	44	45	45	45	45	45	1
LE-6	4,980	56	56	56	56	56	56	1

\*Note: 1 = Combined  
2 = Separate  
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

LAKE ERIE WATERSHED

<u>Area Designation</u>	<u>Area (Acres)</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>*</u>
LE-7	3,958	47	47	50	50	50	50	1
LE-8	2,800	40	45	45	45	45	45	2
LE-9	3,398	25	30	35	35	35	35	2
LE-10	5,115	15	18	20	25	30	30	2
LE-11	5,298	<10	10	12	15	18	20	2
Total	77,741 Acres 121.47 Sq. Mile							
Average Area	7,067 Acres							

CUYAHOGA RIVER WATERSHED

CU-1	2,472	49	49	50	50	50	50	1
CU-2	4,684	47	47	50	50	50	50	1
CU-3	3,562	40	40	45	45	45	45	1
CU-4	23,770	29	35	37	40	45	45	2
CU-5	12,654	31	35	37	40	45	45	1
CU-6	3,995	12	17	25	30	35	35	2
CU-7	4,527	<10	10	15	20	25	30	3
CU-8	8,870	15	17	22	25	30	30	3
CU-9	1,698	<10	<10	<10	10	12	15	3
CU-10	1,846	<10	<10	10	12	15	20	3
CU-11	2,370	20	23	25	30	35	35	2
CU-12	340	20	23	25	30	35	35	2
CU-13	4,500	<10	10	15	20	25	30	2
CU-14	3,425	<10	14	17	20	25	25	3
CU-15	652	<10	<10	10	15	20	20	3

\*Note: 1 = Combined  
2 = Separate  
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CUYAHOGA RIVER WATERSHED

<u>Area Designation</u>	<u>Area (Acres)</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>*</u>
CU-16	1,791	<10	10	15	20	25	25	3
CU-17	1,368	<10	10	15	17	23	25	3
CU-18	551	<10	10	15	20	25	30	3
CU-19	5,730	<10	<10	10	15	20	25	3
CU-20	1,515	<10	14	17	20	25	25	3
CU-21	2,057	<10	<10	10	12	15	18	3
CU-22	1,386	<10	<10	10	12	15	18	3
CU-23	1,240	<10	10	10	15	20	22	3
CU-24	3,388	<10	10	15	20	25	25	3
CU-25	4,472	<10	10	15	20	25	25	3
CU-26	1,221	<10	10	15	17	23	25	3
CU-27	2,874	<10	10	15	20	25	25	2
CU-28	1,634	<10	<10	10	12	15	17	3
CU-29	5,914	<10	<10	<10	10	12	15	3
CU-30	1,974	<10	<10	<10	10	12	15	3
CU-31	1,586	<10	<10	<10	10	12	15	3
CU-32	2,020	<10	<10	10	15	20	20	3
CU-33	1,230	<10	10	15	20	25	25	3
CU-34	2,507	<10	<10	<10	10	15	18	3
CU-35	11,175	<10	<10	10	2	15	17	3
CU-36	3,186	<10	<10		10	12	15	3
CU-37	3,039	<10	<10	<10	10	12	15	3
CU-38	2,121	<10	<10	<10	10	12	15	3
CU-39	3,884	<10	<10	10	12	15	17	3

\*Note: 1 = Combined  
 2 = Separate  
 3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CUYAHOGA RIVER WATERSHED

<u>Area Designation</u>	<u>Area (Acres)</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>*</u>
CU-40	863	<10	<10	<10	10	12	15	3
CU-41	1,130	<10	<10	<10	10	12	15	3
CU-42	1,525	<10	<10	10	10	12	15	3
CU-43	3,765	<10	<10	<10	<10	10	10	3
CU-44	3,094	<10	<10	10	12	14	15	3
CU-45	3,976	<10	<10	10	12	14	15	3
CU-46	1,616	<10	<10	10	15	17	20	3
CU-47	7,833	<10	<10	10	15	17	20	3
CU-48	1,625	25	27	30	35	35	35	2
CU-49	1,304	<10	10	17	25	30	35	3
CU-50	8,228	<10	10	12	15	20	25	3
CU-51	5,492	10	15	17	20	25	30	2
CU-52	1,882	<10	10	15	25	25	30	3
CU-53	3,719	15	20	25	30	35	40	2
CU-54	3,526	18	20	25	30	30	30	3
CU-55	1,900	40	42	45	47	50	50	2
CU-56	2,800	20	25	30	40	45	45	2
CU-57	1,965	<10	<10	12	20	25	30	3
CU-58	7,906	<10	<10	10	12	15	17	3
CU-59	2,249	40	45	50	50	50	50	2
CU-60	2,534	45	50	50	50	50	50	1
CU-61	3,223	30	35	40	45	45	45	1
CU-62	3,150	15	23	32	40	40	40	2
CU-63	1,423	35	37	40	45	45	45	2

\*Note: 1 = Combined  
2 = Separate  
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CUYAHOGA RIVER WATERSHED

<u>Area Designation</u>	<u>Area (Acres)</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>*</u>
CU-64	3,324	50	50	50	50	50	50	1
CU-65	661	45	50	50	50	50	50	1
CU-66	3,085	15	23	32	40	40	40	2
CU-67	2,608	<10	10	15	20	25	30	3
CU-68	1,905	50	50	50	50	50	50	2
CU-69	1,914	15	20	25	35	35	35	2
CU-70	6,327	20	25	30	35	40	45	2
CU-71	2,681	<10	10	12	15	17	20	3
CU-73	1,056	<10	<10	<10	10	12	15	3
CU-74	1,864	<10	<10	<10	10	12	15	3
CU-75	2,663	<10	<10	<10	10	12	15	3
CU-76	872	<10	<10	<10	10	12	15	3
CU-77	2,000	<10	<10	<10	10	12	15	3
CU-78	3,250	<10	<10	<10	10	12	15	2
CU-79	1,360	<10	<10	<10	10	12	15	3
CU-81	486	<10	<10	<10	10	12	15	3
CU-82	551	<10	<10	<10	10	12	15	3
CU-83	835	<10	10	12	15	20	25	3
CU-84	677	<10	10	12	15	20	25	3
Total	262,175 Acres 409 Sq. Miles							
Average Area	3,197 Acres							

\*Note: 1 = Combined  
2 = Separate  
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CHAGRIN RIVER WATERSHED

<u>Area Designation</u>	<u>Area (Acres)</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>*</u>
CHN-1	2,070	20	23	27	30	35	35	2
CHN-2	7,140	10	15	20	25	30	35	3
CHN-3	3,310	<10	10	15	25	25	25	2
CHN-4	1,360	<10	<10	10	15	20	25	3
CHN-5	2,460	<10	<10	<10	10	15	18	3
CHN-6	2,440	<10	<10	10	15	20	25	3
CHN-7	690	<10	<10	10	15	20	20	3
CHN-8	1,110	<10	<10	10	10	15	15	3
CHN-9	1,440	<10	<10	10	15	20	25	3
CHN-10	3,130	10	15	20	25	25	25	3
CHN-11	3,750	<10	<10	<10	10	12	15	3
CHN-12	1,590	<10	<10	<10	10	15	17	3
CHN-13	2,440	<10	<10	10	13	17	20	3
CHN-16	1,600	<10	<10	10	12	15	18	3
CHN-17	1,330	<10	<10	10	12	15	18	3
CHN-18	640	<10	<10	<10	10	12	15	3
CHN-19	710	<10	<10	<10	10	12	15	3
CHN-20	690	<10	<10	<10	10	12	15	3
CHN-21	460	<10	<10	<10	10	12	15	3
CHN-22	740	<10	<10	<10	10	12	15	3
CHN-23	1,230	<10	10	10	15	20	25	2
CHN-24	2,760	<10	<10	<10	10	12	15	3
CHN-25	2,400	<10	<10	<10	10	12	15	3
CHN-26	1,910	<10	<10	<10	10	15	20	2
CHN-27	2,670	<10	<10	10	15	20	25	3

\*Note: 1 = Combined  
2 = Separate  
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CHAGRIN RIVER WATERSHED

<u>Area Designation</u>	<u>Area (Acres)</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>*</u>
CHN-28	2,150	<10	<10	<10	10	12	15	3
CHN-29	660	<10	<10	<10	10	12	15	3
CHN-30	1,070	<10	<10	<10	10	12	15	3
CHN-31	1,580	<10	<10	<10	10	12	15	3
CHN-32	890	<10	<10	10	15	20	25	3
CHN-33	910	<10	<10	<10	10	12	15	3
CHN-34	770	<10	<10	<10	10	12	15	3
CHN-35	1,340	<10	<10	10	12	15	20	2
CHN-36	2,520	<10	<10	<10	10	12	15	3
Total	61,960 Acres 96 Sq. Miles							
Average Area	1,822 Acres							

\*Note: 1 = Combined  
2 = Separate  
3 = Natural Channel

APPENDIX D

ONE YEAR STORM HYDROGRAPHS AND LOADS

This appendix has not been included because of its size. It will be available to interested parties. The original will be included with the submission of reports to the Buffalo District, Corps of Engineers.

APPENDIX E  
SUPPLEMENTAL DATA

In the development of the stormwater alternatives, it became necessary to consider treatment of the 5, 10 and 100 year storm. Therefore, the computer program was used to generate the unit hydrographs for these storms for each of the 162 drainage districts.

This information was not reproduced due to the massiveness of the data and the fact that the 1 year storm was chosen for design purposes. The 1 year storm data is presented in Appendix D of this phase report.

U.S. ARMY CORPS OF ENGINEERS  
BUFFALO DISTRICT

SURVEY SCOPE STUDY  
FOR  
WASTEWATER MANAGEMENT PROGRAM

Contract Phase Report  
Phase II  
Systems Design  
and  
Estimates of Cost

Prepared by  
HAVENS AND EMERSON, LTD.  
CONSULTING ENVIRONMENTAL ENGINEERS  
Cleveland, Ohio  
October, 1972  
Under Contract No.: DACW49-72-C-0048

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## INTRODUCTION

This Survey Scope Study is a continuation of the preliminary work performed under the Feasibility Study in 1971. The Cleveland-Akron area was chosen by the Corps of Engineers as one of the five pilot areas in which to develop a wastewater management program. Three consulting engineering firms have been selected to work with the Corps in developing the Cleveland-Akron Survey Scope Study.

Phase I of the study identified the wastewater management problem with respect to domestic and storm water runoff wastewater as it exists today and as it is anticipated to exist in the future.

This report covers Phase II of the study which identifies treatment processes and effectiveness, design criteria, and unit costs associated with municipal wastewater treatment facilities and storm water treatment facilities. This report does not include, however, any data associated with land treatment of wastewater.

Also included in Phase II of the study were the cost estimates of the twelve alternative plans as developed by Wright-McLaughlin, Engineers.

This report is presented in four sections:

- A - Wastewater
- B - Stormwater Runoff
- C - Alternative Plans - Cost Estimates
- D - Related Information

## A - WASTEWATER

### 1. - TREATMENT PROCESSES AND EFFECTIVENESS

The development of a wastewater treatment plan for a municipality or political jurisdiction has two basic considerations. First, the required effluent quality must be established. Secondly, the applicable process sequence to most economically meet these requirements under local environmental constraints must be selected.

In this section, three basic wastewater management treatment goals are established using State and O.C.E.\* guidelines. Existing process technology is reviewed, and optimum process sequences, as most applicable in Northeastern Ohio, are selected. Schematic and illustrative flow-concentration-mass diagrams are used to characterize and compare unit process and system performance. Influent quality is prevented in Phase I - Section 6.

#### 1.1 - WASTEWATER MANAGEMENT GOALS

Table 1 defines the wastewater management goals for Level 1 and Level 2. Detailed definitions of the required effluent quality are contained in Appendix C.

Level 1 represents the proposed effluent standards of the State of Ohio. The quality criteria contained in Level 1 represent the State's maximum quality criteria. The conventional indices of pollution, such as the 5-Day Biochemical Oxygen Demand ( $BOD_5$ ) and Suspended Solids (SS), vary as a function of the receiving water classification and dilution availability. Allowable phosphorus discharges are defined as a function of the receiving water location and daily discharge volume of wastewater with maximum removals required by 1980. Ammonia nitrogen residuals vary seasonally as a function of the stream classification and available dilution. Effluent

\*O.C.E. - Office of the Chief of Engineers, Department of the Army

dissolved oxygen (DO) concentrations are highest for receiving waters containing cold water fisheries. Allowable fecal coliform bacteria counts vary seasonally and dictate continuous disinfection.

Level 2 represents the O.C.E. Standards for municipal wastewater treatment. The major differences between State and O.C.E. standards are nitrogen removal, COD effluent standards, and increased removals of BOD<sub>5</sub>, ammonia, phosphorus, and suspended solids. The O.C.E. effluent quality goals are independent of stream classification, dilution availability, receiving stream location, wastewater flows, and season of the year. Since the State's maximum effluent DO concentration is more stringent than the O.C.E. standard, it is assumed that an effluent DO of 6 mg/l or more must be achieved in Level 2. The State pH requirements were also assumed to apply for the O.C.E. standards.

#### 1.2 TREATMENT TECHNOLOGY

All wastewater and waste solids treatment processes, excluding disinfection, are designed to promote a gaseous end product or separate and concentrate dissolved and particulate pollutants. The final gaseous or solid phase pollutant end product should be inert and of no pollutional significance in the final disposal site.

Treatment processes can be broadly classified as a function of the unit process goal. This concept is illustrated in Figures 1 (Wastewater Treatment: Unit Process Alternatives) and Figure 2 (Waste Solids Treatment: Unit Process Alternatives), where unit processes are defined in a generalized sequence of treatment steps such that a final product meeting any quality level can be achieved. These unit process flow diagrams should not be regarded as inflexible (often process goals can be and are combined

TABLE 1 - WASTEWATER MANAGEMENT STUDY GOALS

Item	Level 1	Level 2	Level 2 Modified
	5 mg/l	< 5.0 mg/l	< 3.0 mg/l
BOD <sub>5</sub>			
COD		Use 10 mg/l	< 5 mg/l
SS	8 mg/l	< 5.0 mg/l	< 1 mg/l
Total Phosphorus (As P)	0.5 mg/l	< .5 mg/l	0.1-0.2
Ammonia Nitrogen (As N)	2.0 mg/l	< 1.0 mg/l	0.3-0.5
Dissolved Oxygen	6.0	Use 6 mg/l	Use 6 mg/l
Fecal Coliform Bacteria	200/100 ml	200/100 ml	200/100 ml
pH	5-9	5-9	5-9

Level 1 - Extracted from a preliminary draft of proposed effluent standards for municipal, industrial and other wastewaters to the inland waters of Ohio (Water Pollution Control Board, Ohio Department of Health; June, 1972).

Level 2 - Extracted from proposed critical levels for wastewater constituents, letter from NCBED-PB, June 19, 1972 and meeting of July 17, 1972, Washington, D. C. Level 2 also referred to in this report as Federal or OCE Goals.

Level 2 Modified - From "Design Considerations for Advanced Waste Treatment Plants", August 31, Not used as information. Was not available at beginning of phase two work.  
 Note: Inorganic constituents (heavy metals and dissolved solids) are excluded from municipal system design considerations. See report by AWARE.

in one physical unit) nor complete (rapidly expanding technology prevents totality) but rather as an illustration of the treatment alternatives available for application in a municipal wastewater management program. Definition of the management or water quality goals contained in Table 1 in conjunction with the elimination of economically unattractive or insufficiently demonstrated alternatives, reduces the multiplicity of treatment options.

For the purpose of this study, competitive process sequences incorporating basic biological and physical-chemical treatment processes for Northeastern Ohio were developed.

#### 1.21 BASIC BIOLOGICAL TREATMENT SYSTEM

It is safe to conclude that, for the near future, the basic technology for municipal wastewater treatment will be a biological system combined with specific physical or chemical treatment techniques. This technology will most assuredly be applied to large existing wastewater treatment facilities and can be easily incorporated in new facility design.

In attempt to define the "typical" wastewater treatment facility for this area, The 1968 Municipal Waste Facility Inventory (U.S. Department of the Interior, Federal Water Quality Administration) reports the following for the Lake Erie Drainage Basin:

1. 98 percent of the population receives some form of wastewater treatment;
2. 79 percent of the population receives secondary treatment, of which, 93 percent is serviced by the activated sludge process or modifications thereof.

From the preceding, it can be seen that the foundation for an effective wastewater management program is already established: wastewater

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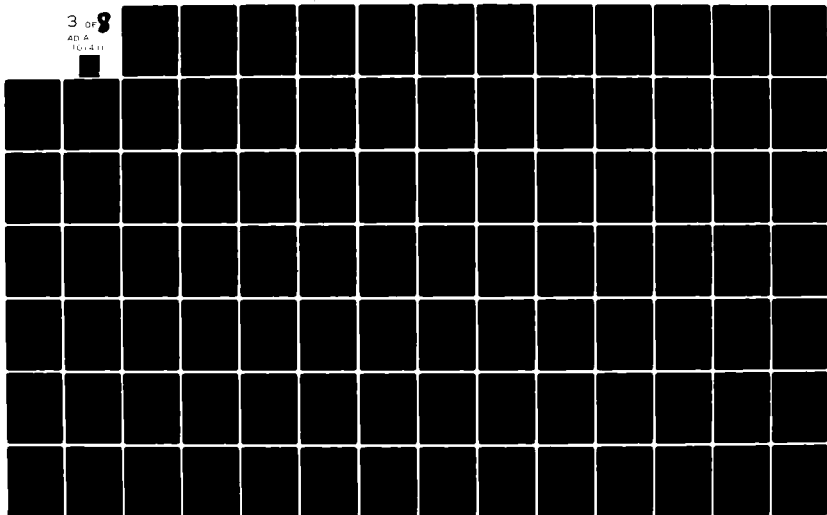
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collection and transport to a treatment site, and use of the activated sludge process as the representative treatment concept. Therefore, the activated sludge process with an aeration contact time of 4.5 to 6 hours is assumed as the one that must be upgraded to meet the various wastewater management goals listed in Table 1. The basic activated sludge system is shown schematically in Fig. 3, with anaerobic solids digestion followed by vacuum filtration and incineration. Typically, waste solids cake and incinerator ash are ultimately disposed of upon municipal landfill operations.

To provide a basis of comparison, the unit and overall equilibrium process performance of this system was prepared for the estimated 1990 influent wastewater quality as illustrated in Figure 3A. This system would only meet the proposed  $BOD_5$  and SS criteria for Ohio's Class III streams (free flowing, warm water fisheries) if the average upstream  $BOD_5$  concentration increase was no more than 1 mg/l.

#### 1.22 BASIC PHYSICAL-CHEMICAL TREATMENT SYSTEM

Physical-chemical treatment systems, when applied, will most likely be at new treatment sites or as additions to existing primary facilities. In terms of volume, the largest of the new physical-chemical systems presently proposed will be at Cleveland's Westerly Wastewater Treatment Plant where a physical-chemical system incorporating single stage lime coagulation with lime recovery and reuse, recarbonation, filtration and granular activated carbon adsorption, regeneration and reuse is proposed. Alternative systems, such as at Rocky River, Ohio, replace lime addition with polymer applications for suspended solids removal and add metal salts to meet phosphorus removal requirements. The Cleveland Westerly plant was assumed

the representative physical-chemical system for this study and its flow pattern is shown schematically in Figure 4.

Equilibrium system performance is illustrated in Figure 4A for the 1990 influent wastewater quality. The system, as proposed, is designed to maximize the phosphorus removal to lime dosage ratio with an influent wastewater alkalinity of 175 mg/l as  $\text{CaCO}_3$ . At a lime dose of about 240 mg/l as  $\text{Ca(OH)}_2$ , a reaction pH of about 10.5 should result. At this pH minimal  $\text{Mg(OH)}_2$  precipitation will result and calcium solubilization will be minimal (thus, maximizing  $\text{CaCO}_3$  formation). Recarbonation is provided to adjust the wastewater pH prior to carbon adsorption and to solubilize any effluent  $\text{CaCO}_3$  to prevent encrustation of the filter. The filtration system is provided to protect the activated carbon system from particulate solids. The granular activated carbon system is shown with air or oxygen applications to prevent problems with septicity and effluent clarity and to meet effluent dissolved oxygen concentrations. A 30 percent wastage of calcined ash was assumed in the lime recovery and reuse system.

The proposed physical-chemical system, as shown, can meet Ohio's proposed minimum  $\text{BOD}_5$  and SS effluent standards for Class I (cold water fisheries) and Class II (scenic waters) streams when the average  $\text{BOD}_5$  concentration increase at critical stream flows is less than 0.3 mg/l and some Class III and Class IV (pooling waters with warm water fisheries) receiving streams. Ohio ammonia nitrogen effluent standards for November through March with Class III and IV streams are satisfied if the calculated ammonia concentration in the stream does not exceed 0.05 mg/l. The 1980 Ohio effluent phosphorus standards are satisfied for discharges of less than 10 mgd into Lake Erie and its tributaries. If the discharge is into a lake, reservoir, impoundment or pool, the system meets the proposed

phosphorus standard only when discharged volumes of wastewater are less than 1 mgd.

In comparing Figures 3A and 4A, fundamental differences between biological and physical-chemical systems become apparent. These are briefly reviewed.

a. Waste Solids

Waste sludge solids are generally higher for a physical-chemical system. Oftentimes, this is partially compensated for by improved dewaterability. The utilization of lime rather than a metal salt as the primary coagulant causes this difference to be especially pronounced.

b. Soluble Organic Removal

Economic and performance success or failure of this process goal in a biological system is dependent upon the main stream reactor and solids separation; whereas with a physical-chemical system it is dependent upon the main stream reactor and sidestream activated carbon regeneration and reuse. The biological system cannot remove highly refractory (non-biodegradable) organics, but when effluent standards are developed in terms of  $BOD_5$ , nondiscriminate bio-degradeable and refractory organic removal by activated carbon make very low  $BOD_5$  residuals difficult to achieve. A biological system metabolically converts about 1/4 to 1/2 of the applied organic carbon to  $CO_2$  which is discharged to the atmosphere; in a strict sense, the physical-chemical system must handle this additional organic carbon which is not removed until carbon regeneration upon application of external energy or fuel. Although biological system can be upset by inhibitory wastes, activated carbon organic adsorption performance is pH dependent for organic acids and bases, anionic and

cationic surface active agents, and ampholytes; their removal cannot be simultaneously optimized for in a municipal wastewater since adjustment of pH may increase the removal of one organic compound while suppressing adsorption of others.

c. Costs

Generally, a trade-off is made when selecting biological versus physical-chemical systems. A physical-chemical system will usually show lower capital costs with its shorter reactor times. However, its operating expenditures and energy costs are generally higher than biological systems because of chemical costs and side-stream regeneration requirements. In urban areas with very little available land, the smaller land requirement of the physical-chemical system imparts an obvious advantage over biological systems. Generally, the physical-chemical components have a shorter life because of the larger amount of mechanical equipment which in turn tends to increase the total annual cost.

d. Unknowns

The disadvantages of the more conventional biological systems are well known and understood because of 40 or more years of experience. However, there are a number of unknowns about a physical-chemical process which may reduce its superficial attractiveness. For example, a lime-carbon system on raw wastewater application has not yet been supported by the successful demonstration of lime and activated carbon regeneration and reuse. Temperature influences upon carbon adsorption effectiveness represent an almost total unknown as well as the necessary reserve capacity to satisfy largely unbuffered diurnal flow and organic variations normally exhibited in municipal wastewater treatment.

In the following sections, these two basic wastewater treatment concepts are upgraded to meet the effluent quality levels listed in Table 1. It is thought that these process schemes represent an optimum and realistic application of today's technology to meet future treatment goals. Where applicable, fundamental comparisons of design alternatives are discussed and major risks and unknowns briefly enumerated.

### 1.3 - PROCESS SEQUENCE SELECTION AND PERFORMANCE

#### 1.31 - LEVEL 1: PROPOSED STATE GOAL

**BIOLOGICAL TREATMENT SYSTEM:** The proposed Ohio effluent standards or state goal can be met by achieving ammonia oxidation (nitrification), applying metal salts for phosphorus removal, controlling effluent solids by organic polymer addition and in-depth filtration, and practicing post aeration. The upgraded biological system is shown schematically in Figure 5. System performance is illustrated in Figure 5A. As shown on these figures, the solids handling system has also been modified to include gravity waste activated sludge thickening and heat conditioning of the combined raw sludge after storage.

To achieve nitrification, the existing aerator has been separated into a 1/3 - 2/3 (high rate - nitrifying) volumetric split which would result in a nitrifying contact time of 3 to 4 hours, assuming the original aerator contact time was 6 hours. This new nitrifying contact time should be adequate for the climatic conditions of Northeastern Ohio. A new final clarifier is necessary to allow the complete separation of the two distinct biological cultures, designed for the removal of carbonaceous and nitrogenous oxygen demanding materials respectively. This system alternative for nitrification was selected over other possibilities (i.e., chemical additions and solids control in the primary clarifier, extended aeration) because in a general application this alternative gives the greatest assurance of economic performance success. It is also most compatible with metal salt addition for phosphorus removal and maximizes the potential for a low soluble BOD<sub>5</sub> residual.

Metal salt addition for phosphorus removal was selected because the chemical requirement is largely a function of the pollutant of concern, phosphorus, and the required soluble residual. Thus, should phosphorus levels in the influent wastewater be reduced by local or federal legislation or

should detergent reformulations occur in the future, the municipality will be able to reduce metal salt applications and derive proportional savings. As shown, metal salt additions for phosphorus removal do not require additional capital facilities other than a chemical storage and feed complex. Any source of precipitating metal ion, including some industrial wastes, can be used, but because of the generality of this study the alternatives have been reduced to commercially available ferric and aluminum salts, i.e., ferric chloride and alum. Aluminum was selected over ferric iron because of its higher pH value of optimum phosphorus precipitation (about 6 versus 5), its lower mass of precipitated solids, its precipitate's integrity during reducing conditions, and the absence of potential color problems in the final effluent. Although the metal salt can be added to any point in the major process stream, dosing to the aerator effluent was selected to maximize hydrolysis of influent complex phosphorus forms, minimize competing soluble phase side reactions due to raw waste organic components, and minimize floc shearing and upwards pH drift due to shearing and carbon dioxide stripping in the aerator. Dosing the chemical to the activated sludge system does not attenuate process performance but, rather provides a stabilizing influence upon the system due to the weighting effect derived from the inorganic precipitate within the activated sludge floc which results in a denser, faster settling floc. Chemical additions into the secondary also results in the accumulation of chemical precipitate which provides a buffer against diurnal phosphorus concentration peaks and lessens the sensitivity of chemical application rates to fluctuations in raw sewage phosphorus concentrations. A polishing dose of metal salt is added to the nitrifying activated sludge system to produce the required effluent phosphorus residual of 0.5 mg/l. By incorporating split-chemical treatment, only a small additional dose of aluminum is required, and the resultant

precipitated solids would not be expected to upset the system. The liability of metal salt addition for phosphorus removal is the introduction of extraneous ions which, in some instances, can be considered contaminants in their own right. In the case of alum, approximately 5.3 parts of sulfate are introduced per part of aluminum added. Although sulfate levels will increase over background levels, a net dissolved solids increase does not result due to the almost completely compensating removal of phosphate and other soluble phase pollutants.

Polymer addition and some physical means of final effluent solids control are design necessities when low phosphorus residuals are required whether or not low  $BOD_5$  and SS residuals are treatment necessities. Polymer addition usually is a treatment necessity because of the colloidal haze that can occur with high dosages of precipitating chemicals. Anionic polyelectrolyte addition in conjunction with aluminum additions has resulted in excellent process stream clarity after simple sedimentation. The filtration system provides positive backup for the system and further effluent polishing. A dual or multi-media filtration system has been selected because of the low effluent suspended solids required. Examining the process streams before (E-2) and after filtration (FE) in Figure 5A shows that although the State  $BOD_5$  and SS effluent standards can be met before filtration, precipitated phosphorus in the solids phase dominates, and effluent solids control by filtration should be provided. In the final effluent, differences between total nitrogen ( $N_t$ ) and oxidized nitrogen (N-O) will largely consist of a soluble refractory organic nitrogen residual with ammonia nitrogen concentrations at trace levels. Lime additions in the nitrification system for this wastewater were necessary because of anticipated alkalinity depletions associated with metal salt addition and nitrification.

Chlorine dosages for disinfection would be reduced due to the absence

of ammonia nitrogen in the final effluent. No credit was taken for BOD<sub>5</sub> and ammonia removal through the disinfection system. Chlorination for final effluent disinfection is an acceptable practice under current State and Federal regulations, even though chlorinated effluents can possess a certain toxicity to aquatic life. If not acceptable in the future, dechlorination can be practiced by chemical additions, i.e., sodium bisulfite, sulfite, thiosulfate or activated carbon adsorption.

To produce consistently an effluent with a dissolved oxygen concentration of 6 mg/l or more in the summer, a post-aeration step is necessary. The post-aeration step could be added before, during, or after conventional chlorination for disinfection.

In the waste solids handling system, gravity waste activated sludge thickening was provided over such alternatives as dissolved air flotation because it was felt that the weighting action of the inorganic precipitates should serve as a concentrating aid. Waste activated sludge return to the primary sedimentation tank was eliminated because of inevitable problems with solids resuspension and poorer capture. Although no problems would be expected with the anaerobic digestion system due to the inorganic precipitates, the additional mass of waste biological solids due to the high rate activated sludge system, and improved main stream solids capture may impair the operation of the anaerobic digester. In addition, it is not unreasonable to expect that the vacuum filter cake for this condition would slightly increase in its water content. Therefore, the primary digester was converted to a storage tank, heat conditioning of sludge solids was incorporated, and the secondary digester was converted to a decanting-storage facility. Heat conditioning offers the advantages of consistency in vacuum filter operation, increased cake dryness, high cake BTU values, and a "sterile" end product should conditioned

sludge application to the land be contemplated. Its disadvantages center upon the magnitude of volatile solids solubilization which, if not completely biodegradeable, can deteriorate effluent organic values and will increase the mass of waste activated sludge. Nitrogen solubilization will be similar to that encountered with anaerobic digestion achieving 50 percent solids destruction. If considered in the basic design, the disadvantages associated with heat conditioning can be compensated for in system sizing.

Whether or not gravity waste activated sludge thickening and heat conditioning are incorporated, the final effluent from this plant will easily meet or exceed the proposed Ohio effluent standards. The aluminum-organic sludge may be incinerated or spread directly on the land. With land applications, the soil building and fertilizing benefits derived from the solid's organic fraction will more than compensate for any deleterious effect associated with the inorganic aluminum precipitates.

PHYSICAL-CHEMICAL TREATMENT SYSTEM: To meet the proposed Ohio effluent standards, the basic physical-chemical system must be upgraded to provide additional phosphorus and  $BOD_5$  removal as well as incorporate a physical system specifically intended for ammonia nitrogen removal. To this end, a second stage flocculator-clarifier has been incorporated with breakpoint chlorination followed by additional carbon adsorption. Additional post aeration is a necessity to meet an effluent dissolved oxygen value of 6 mg/l or greater. The upgraded physical-chemical system is shown schematically in Figure 6 with its performance characterized in Figure 6A.

The reaction pH in the first stage flocculator-clarifier must be increased to 11.5 from 10.5 to achieve the additional phosphorus removal. This requires the lime dose to increase by almost 80 percent and necessitates the addition of a second-stage flocculator-clarifier to capture the precipitated

calcium carbonate following recarbonation to a pH 9.5. This results in an almost 50 percent increase in waste solids mass due to the additional calcium carbonate and precipitated magnesium hydroxide. A polishing dose of metal salts for phosphorus removal was not possible because of a lack of pH compatibility in the main and/or waste solids streams. The performance and chemical requirements for phosphorus removal with this system are largely independent of incoming phosphorus concentrations but vary as a function of pH dependent solubility products and the wastewater alkalinity. Thus, the system is insensitive to diurnal variations in phosphorus concentration but cannot be expected to return any economic savings should raw sewage phosphorus levels be reduced in the future.

In a physical-chemical system ammonia nitrogen removal cannot be by simple conversion to nitrate nitrogen but must be an actual physical removal. Commonly visualized techniques with today's technology are ammonia stripping, ion exchange, and breakpoint chlorination.

Ammonia stripping is compatible with lime treatment at pH values of 11 or greater but even if ammonia fluxing to the atmosphere were allowed, it suffers from physical scaling problems and performance limitations at ambient air temperatures less than 40° to 45°F.

Ion exchange using clinoptilolite, a naturally occurring zeolite, can produce an ammonia nitrogen residual of about 0.5 to 1.0 mg/l but questions with resin attrition, recovery and reuse as well as ultimate ammonia concentrate disposal still remain. If it is assumed that ultimate ammonia disposal to the atmosphere is not allowed, four alternatives for disposal of waste brine remain: breakpoint chlorination, biological nitrification and denitrification, disposal of a weak  $\text{NH}_4\text{OH}$  solution to an available market, and evaporation to a point where the dried salts can be handled directly in an incinerator. Since alternatives one and two offer no particular advantages over main stream contacting, and alternative three has no application in a generalized

study, only alternative four remains. It is thought, that the cost of drying this brine would be economically prohibitive in comparison to main stream breakpoint chlorination.

Breakpoint chlorination, following carbon adsorption for organic nitrogen removal, will produce a total effluent nitrogen of about 2 mg/l (about 1 mg/l organic nitrogen, 0.5 mg/l ammonia trichloride, and 0.5 mg/l oxidized nitrogen) with direct ammonia removal to nitrogen gas. This system suffers from the liability of dissolved solids addition and generally necessitates chemical additions for pH control. Clearly, for physical-chemical systems (including such exotic processes as distillation) the nitrogen removal question through ultimate disposal may determine their general applicability in wastewater treatment.

Ammonia removal by breakpoint chlorination is proposed as the means of meeting the proposed Ohio effluent standards for a physical-chemical system since at this point in time it has the least amount of unknowns and potential operating difficulties. It has the advantage that operating costs are directly a function of the applied ammonia mass and the required effluent residual. Should it be infeasible to handle the magnitude of chlorine indicated, either by purchase or on-site generation, the alternative technique would be ion exchange with ultimate ammonia disposal by evaporation and incineration.

As noted in Figures 6 and 6A, the breakpoint chlorination system is incorporating an expanded disinfection tank following the first stages of carbon contacting to remove organic nitrogen and competitive chlorine demanding materials. It is followed by a downflow carbon contactor for additional solids removal, dechlorination, and additional organic removal (included any chlorinated hydrocarbons formed during breakpoint chlorination). No actual organic (COD) removal was taken during the actual breakpoint operation because of the very slow reaction rates without such catalysts as

ultra-violet radiation. Obviously, effective disinfection and virus kill will occur during breakpoint chlorination. Post aeration should be provided either before or after the final stage of carbon contacting.

#### 1.32 - LEVEL 2: PROPOSED TREATMENT GOAL

ADVANCED BIOLOGICAL TREATMENT SYSTEM: Biological nitrogen and refractory organic removal must be provided to meet the O.C.E. effluent standards. In terms of new capital facilities, as shown in Figure 7\*, the system used to meet Level 2 must be a denitrification reactor, aerated channel, final clarifier and a carbon adsorption system with regeneration and reuse. Process performance is illustrated in Figure 7A\*.

The alternative systems for biological denitrification are suspended versus attached growth reactors. Denitrification, like nitrification, is a temperature sensitive reaction where contacting times per unit mass of biological flora and cell residence times are both temperature dependent. A suspended growth reactor was selected over an attached growth system (coarse filter) because of its greater operating flexibility under the temperature variations encountered in Northeastern Ohio. Methanol is added to the system to serve as the driving carbonaceous substrate and to accelerate the biological reduction of nitrate to elemental nitrogen gas. The magnitude of methanol addition is dependent upon the oxidized nitrogen mass into the unit and the required treatment efficiencies; effluent oxidized nitrogen values of 1.0 mg/l are easily obtained with no methanol breakthrough.

The polishing metal salt dose has been transferred to the end of the denitrification reactor and increased to achieve the required phosphorus residual. As shown in Figure 7A\*, low phosphorus residuals are easily achieved with split chemical treatment.

\*Federal Effluent Standards refer to standards established by O.C.E. (Office of the Chief of Engineers).

The required effluent COD is only achieved with additional treatment for refractory organic removal even though BOD<sub>5</sub> and suspended solids goals are satisfied after denitrification and filtration. The activated carbon requirement for this application is only about 1/10 to 1/5 of that associated with the physical-chemical system upgraded to satisfy the proposed state effluent standards (Figure 6A). Similar savings are derived in the spent carbon dewatering and regeneration system and makeup carbon storage. To produce an effluent free of chlorine toxicity, the disinfection facility could be located prior to carbon adsorption. However, since the chlorine dose for disinfection would undoubtedly be low, the disinfection facility has been left as the final treatment process in the treatment scheme.

ADVANCED PHYSICAL-CHEMICAL TREATMENT SYSTEM: Figure 8\* shows schematically the upgraded physical-chemical system to satisfy the proposed O.C.E. effluent standards. The system's performance is illustrated in Figure 8A\*. Ozonation is incorporated as the means of further effluent polishing.

Ozonation was necessary because it is doubtful if a physical-chemical treatment system incorporating activated carbon adsorption can achieve the required soluble organic concentrations due to the previously mentioned pH influences upon adsorption effectiveness. Ozonation will simultaneously provide further disinfection and achieve the required effluent dissolved oxygen concentrations.

### 1.33 - LEVEL 3: MAXIMUM REUSE APPLICATION

In the water-rich area of Northeastern Ohio, the probability of wastewater renovation for direct potable reuse is very remote. However, the two basic treatment systems have been carried to this point to illustrate the technological requirements and probable process performance. Furthermore, although total stream treatment is shown, it is projected that in

\*Federal Effluent Standards refer to standards established by O.C.E. (Office of the Chief of Engineers).

the future, fractions of the major process stream would be diverted to constant flow minor process sequences specifically designed to produce a product water to match the intended reuse application.

ADVANCED BIOLOGICAL AND PHYSICAL-CHEMICAL TREATMENT SYSTEMS: To meet the ultimate product water goal of direct potable reuse, both basic treatment systems must be upgraded for demineralization and "fail-safe" treatment redundancy. The unit process selected for this is reverse osmosis. Schematic flow and process performance diagrams for the upgraded biological system are shown in Figures 9 and 9A with similar diagrams for the upgraded physical-chemical system contained in Figures 10 and 10A.

Reverse osmosis was chosen over the other available demineralization processes (distillation, electrodialysis, and ion exchange) because it is the one process technique which potentially could replace all the preceding unit processes. In other words, it offers a capability of backing up and supporting the total treatment system giving 100 percent pollutant removal redundancy with the added benefit of demineralization. Such a unit process is necessary in a closed recycle system because of the potential buildup of trace organic carbonaceous and nitrogenous pollutants which may be unremovable in the upstream treatment unit processes.

It is likely that the buildup of these trace pollutants and their successful elimination will be more of an operational consideration than demineralization in a closed system and, thus, demand total flow treatment rather than split treatment to achieve some higher, tolerable dissolved solids in the final effluent. No other treatment concept offers the treatment potential of reverse osmosis. Unfortunately, the state of today's technology will not allow it to supersede the upstream systems due to flux and membrane fouling limitations. These problems are likely

to be solved in the future; leaving only the question of what to do with the waste brine.

In Northeast Ohio, assuming that brine disposal to underground cavities or surface waters is invalid, there is little choice but to go through an evaporation system where it must be dried to a point that it can be handled directly in an incinerator. The water in this brine cannot be recovered by direct distillation since as the waste volume is reduced the potential of distillate contamination by organics and residual ammonia will increase. Multiple redistillation or distillate treatment (carbon adsorption, ion exchange, etc.) are possible but would mean that higher purity water is only achieved with smaller recovered produce water volumes. This illustrates a fundamental fact of wastewater treatment, namely: zero contaminants in a product water are found only with zero product water.

In the upgraded biological system, the dried mineral salts can be handled in an expanded incineration system in conjunction with the organic solids. Whereas, in the upgraded physical-chemical system which incorporates solids reuse, the evaporated mineral salts must be handled separately in a unique incineration system to avoid fractional solubilization upon reuse.

Both systems are followed by final chlorine disinfection for consumer protection in the event of distribution system contamination. An off-stream storage tank is provided should consumer demands not coincide with wastewater flows.

Table 2 presents a comparative summary of the effluent quality achieved from the various levels of treatment as previously described.

TABLE 2

## EFFLUENT QUALITY (mg/l)

<u>Treatment</u>	<u>Suspended Solids</u>	<u>BOD<sub>5</sub></u>	<u>COD</u>	<u>TOD</u>	<u>Total Nitrogen</u>	<u>Total Phosphorus</u>	<u>Figure No.</u>
Basic Biological Treatment Plant	25	15	69	113	19.7	10.2	3A
Basic Physical-Chemical Treatment	5	15	45	89	13.1	0.7	4A
Level 1, Biological Treatment Plant	2	4	26	10	17.2	0.5	5A
Level 1, Physical-Chemical Treatment	2	5	15	14	2.0	0.2	6A
Level 2, Biological Treatment Plant	0	0	8	1	0.7	0.1	7A
Level 2, Physical-Chemical Treatment	1	0	8	7	2.0	0.2	8A
Level 3, Biological Treatment Plant	0	0	1	0	< 0.1	0	9A
Level 3, Physical-Chemical Treatment	0	0	1	1	0.2	0	10A

#### 1.4 MISCELLANEOUS DESIGN ASSUMPTIONS

##### 1.41 HYDRAULIC SURGE CONTROL

In the design of these systems, the necessity of dampening hydraulic surges in the treatment systems has not been mentioned. Generally, for plant flows of 10 mgd or less, hydraulic surge control would be a worthwhile consideration because of wide diurnal variations. At higher daily flow rates hydraulic peaks are usually dampened because of the large service area. The necessity of providing positive influent flow control would be subject to the particular flow patterns found or anticipated at the treatment site. If flow equalization or surge control is necessary, an expanded sedimentation tank receiving the mixed liquor solids from the activated sludge system designed for the removal of carbonaceous materials would be recommended for the basic biological treatment system whereas with the basic physical-chemical treatment system a separate flow equalization chamber following chemical treatment would be recommended.

##### 1.42 REMOVAL OF HEAVY METALS, PESTICIDES, CHLORINATED HYDROCARBONS, RADIOACTIVE MATERIALS

In the design of municipal wastewater treatment systems, specific process designs to remove the above pollutants were not considered since control at the source has been postulated in these studies. However, many of the unit processes contained in the treatment sequence can and do provide positive removals. Generally, with the exception of aeration stripping, the processes will concentrate these pollutants in waste solid streams which with and without incineration will reduce the feasible alternative for ultimate waste solids removal. As a review, the pollutants and unit processes for removal are summarized below:

Heavy metals - "sorbed" onto biological floc, some precipitated  
with alum and trace quantities of sulfide, organic  
compounds adsorbed upon activated carbon, excellent

removal generally found with high pH lime treatment reverse osmosis should provide good removal. With or without incineration, possibility of resolubilization under microbial action in final disposal site exists.

Pesticides and Chlorinated Hydrocarbons - "sorbed" onto biological floc and can be fractionally stripped into atmosphere via the biological aeration systems. Adsorbed upon activated carbon with backup support provided by reverse osmosis. Permanent oxidation provided under incineration or carbon regeneration at elevated temperatures.

Radioactive Materials - See heavy metals for removals, complete capture may be impossible. Final destruction technique is time dependent upon given half-lives. Distribution in gaseous, liquid and solid phases after treatment can be expected.

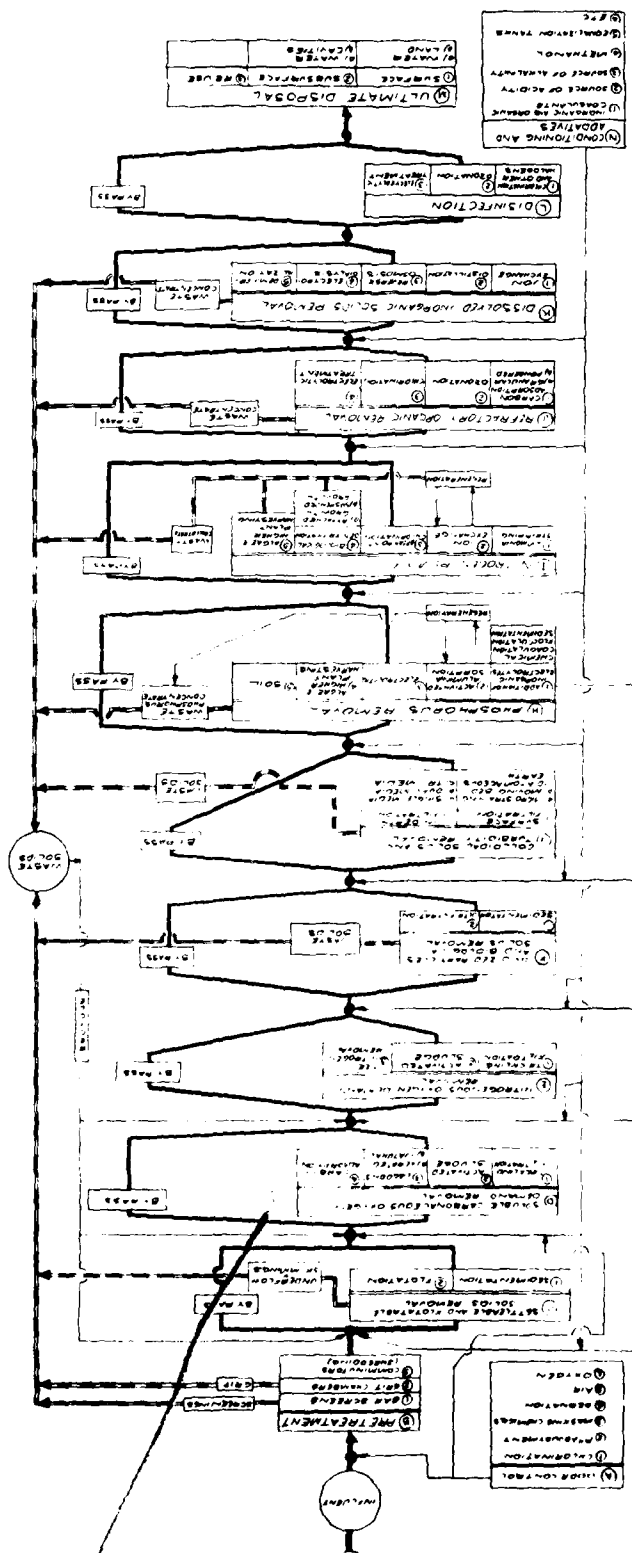


FIGURE-1  
WASTEWATER TREATMENT UNIT PROCESS ALTERNATIVES  
A25  
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FIGURE 2 - WASTE SOLIDS TREATMENT: UNIT PROCESS ALTERNATIVES

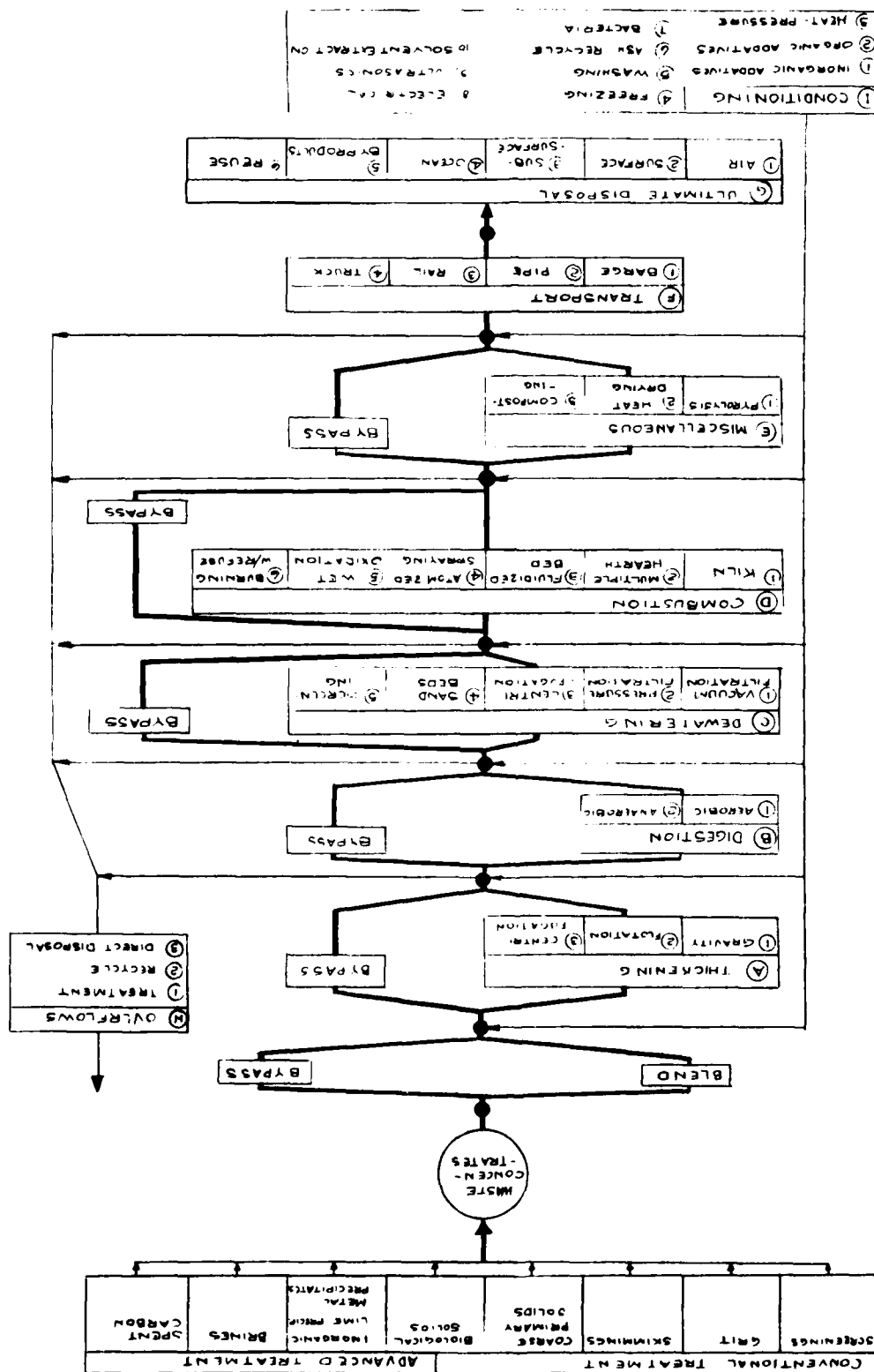


FIGURE 2

WASTE SOLIDS TREATMENT: UNIT PROCESS ALTERNATIVES

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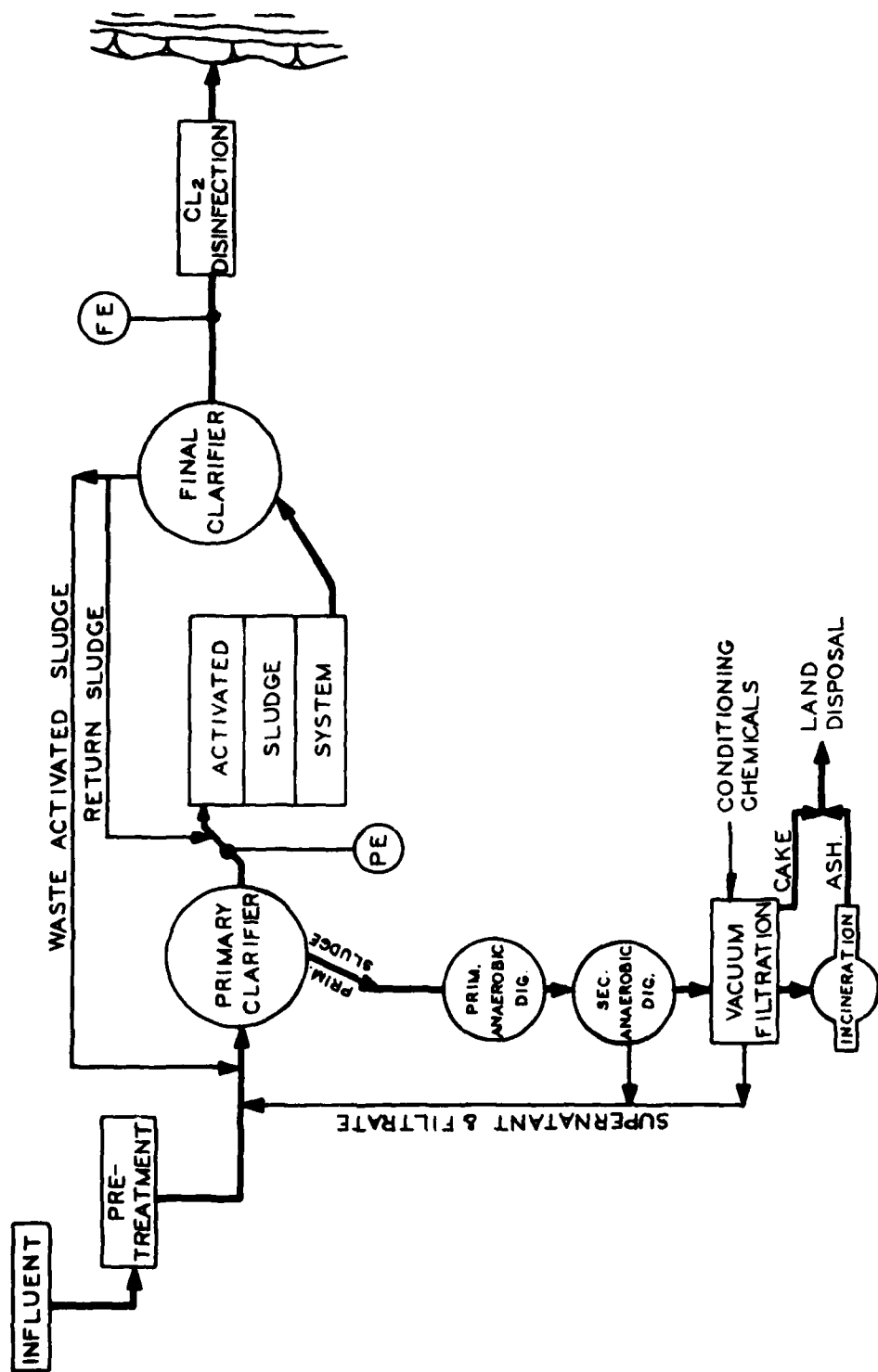
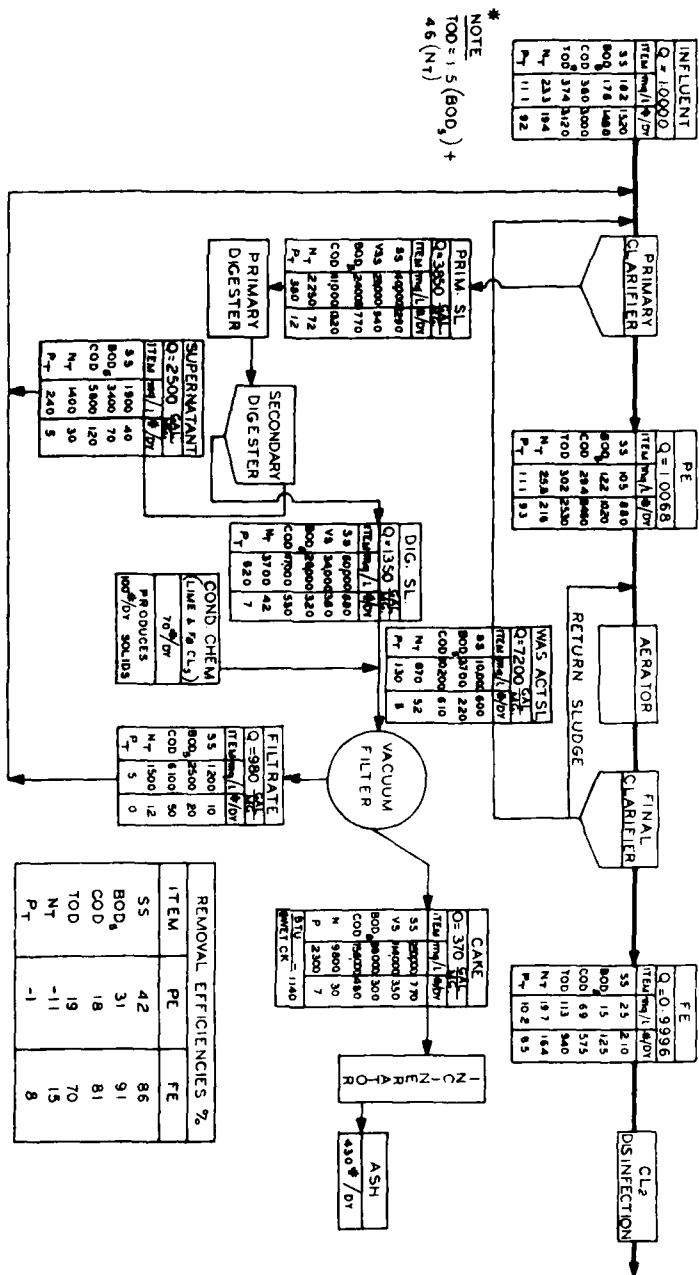


FIGURE 3  
BASIC BIOLOGICAL TREATMENT SYSTEM

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FIGURE 3A  
BASIC BIOLOGICAL TREATMENT SYSTEM  
PROCESS PERFORMANCE

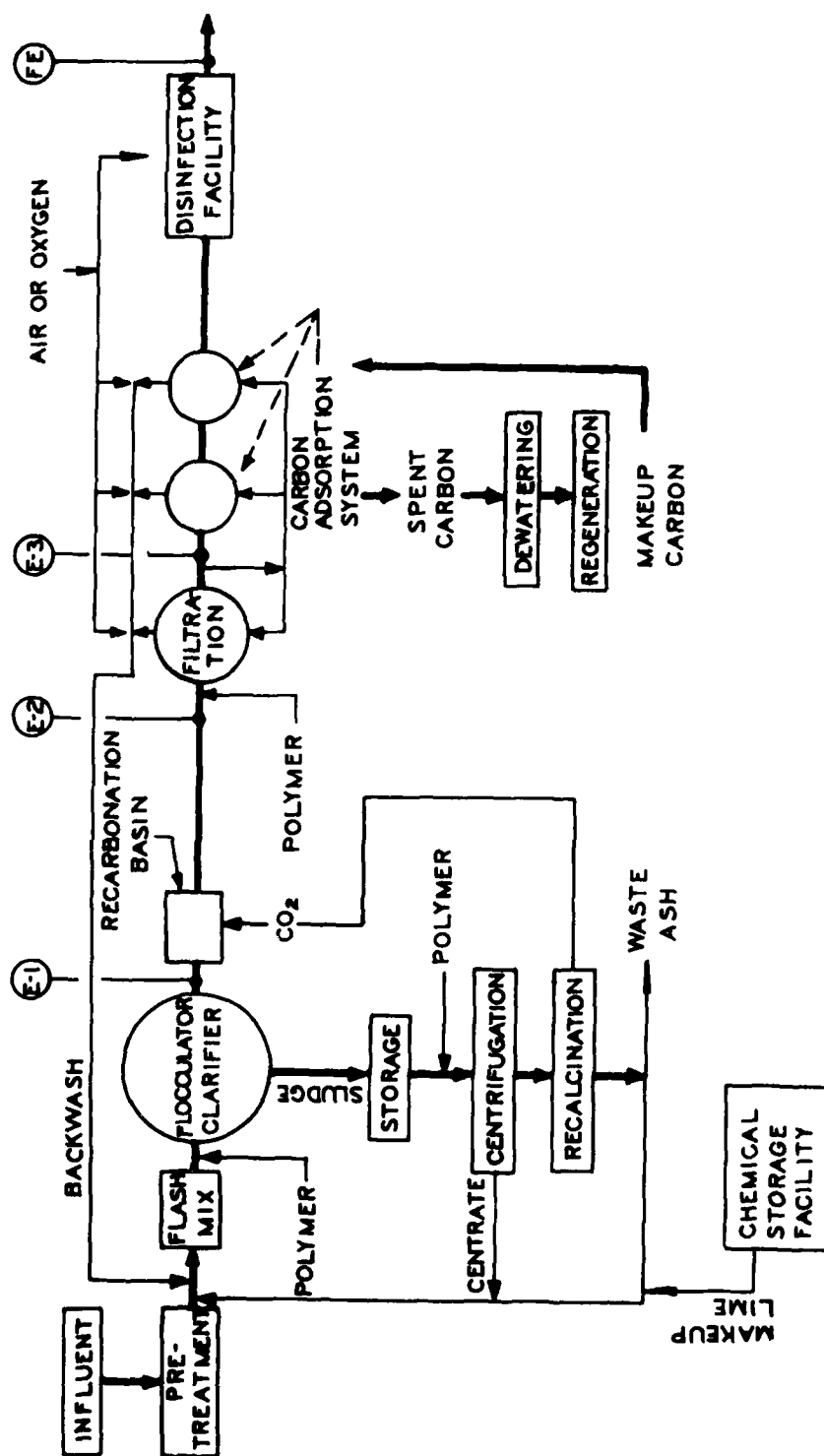
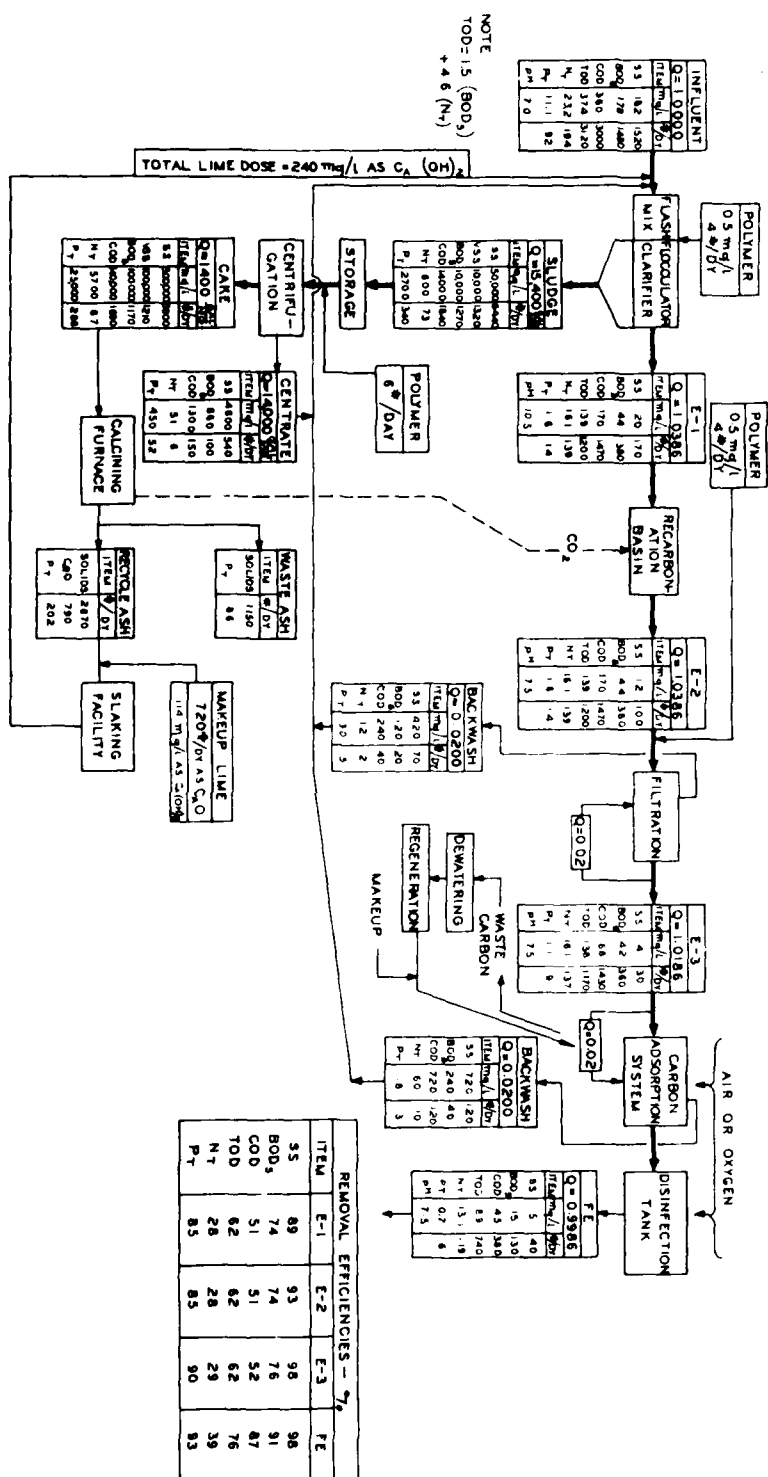


FIGURE 4  
BASIC PHYSICAL-CHEMICAL TREATMENT

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FIGURE 4A

BASIC PHYSICAL-CHEMICAL TREATMENT SYSTEM

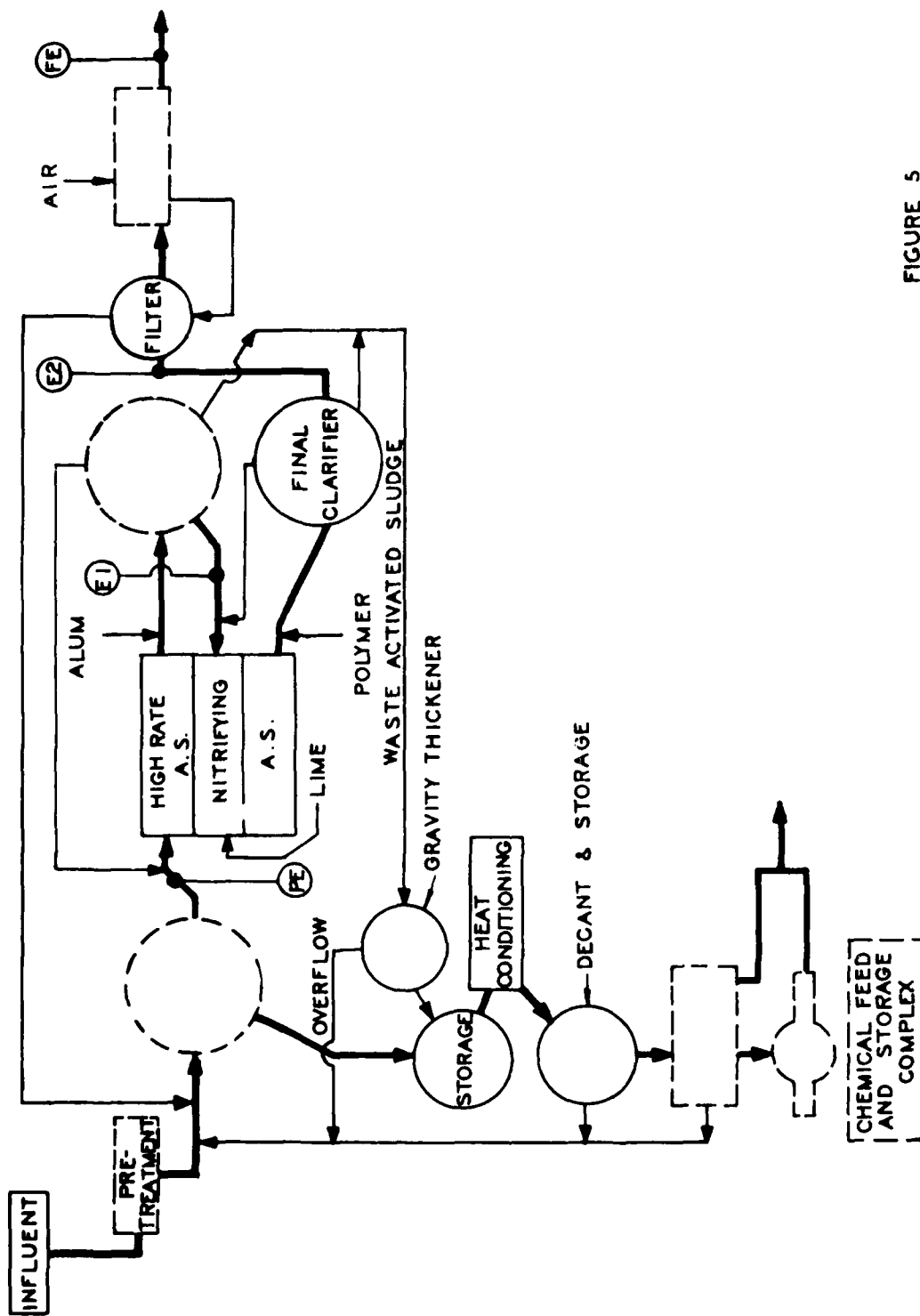
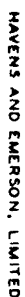


FIGURE 5  
BASIC BIOLOGICAL TREATMENT SYSTEM  
UPGRADED TO MEET STATE  
EFFLUENT STANDARDS

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**FIGURE 5A**  
**BASIC BIOLOGICAL TREATMENT SYSTEM**  
**UPGRADED TO MEET STATE**  
**EFFLUENT STANDARDS:**  
**PROCESS PERFORMANCE**

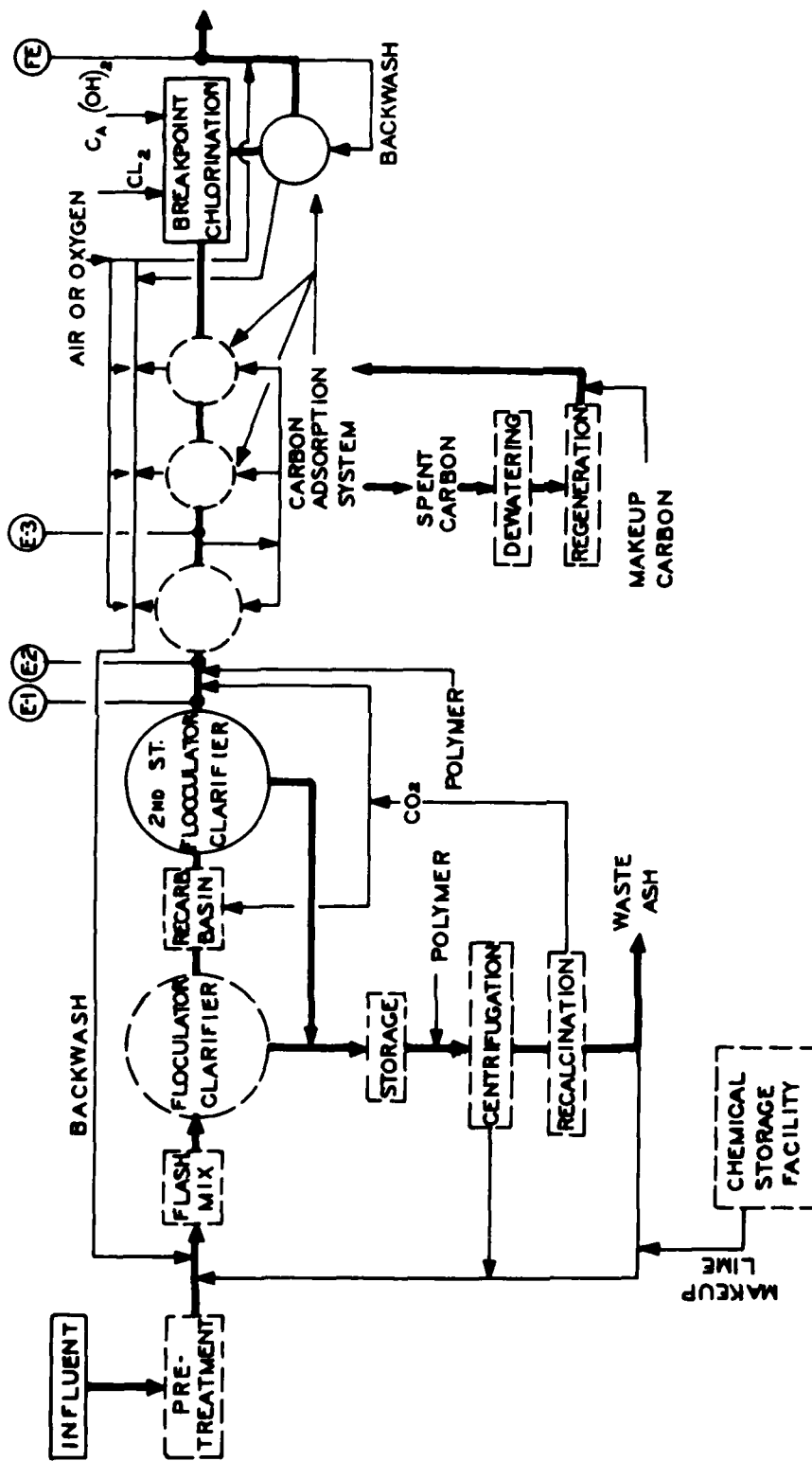
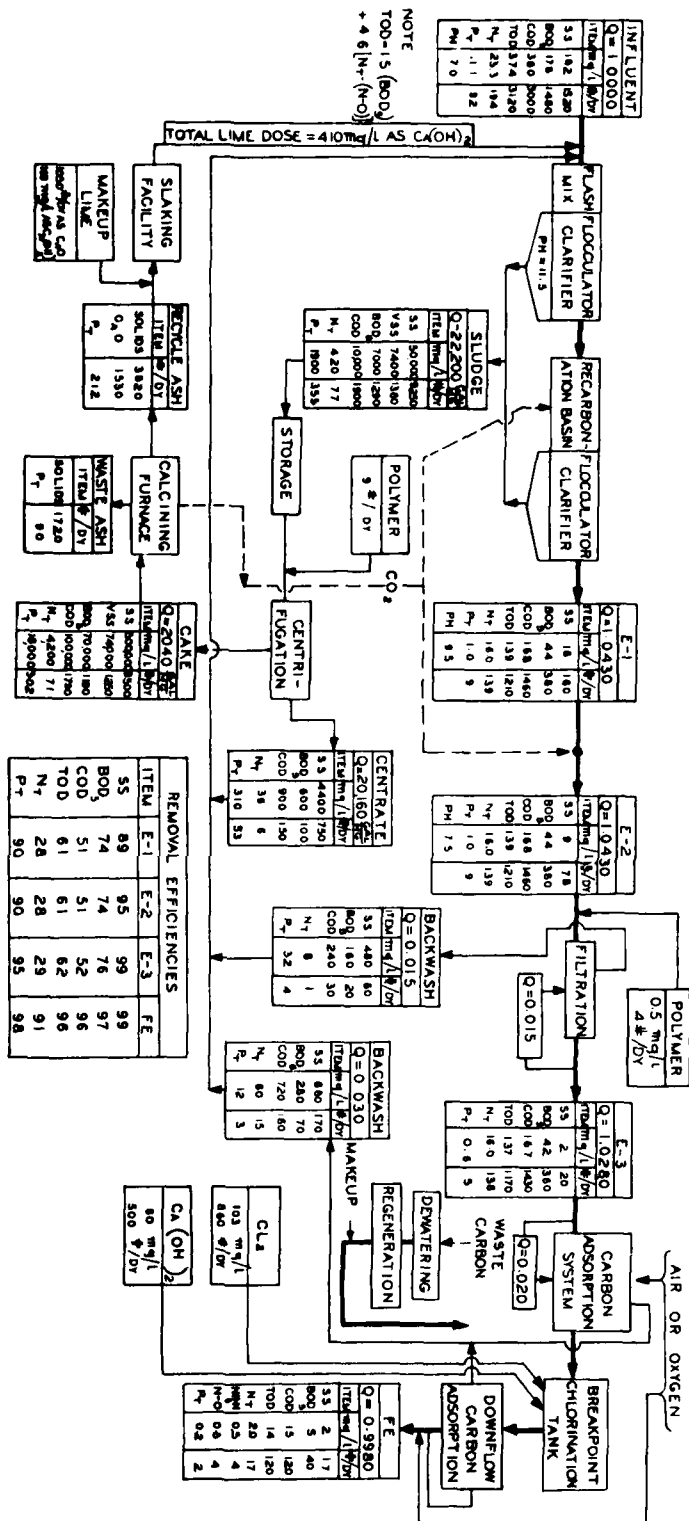


FIGURE 6  
BASIC PHYSICAL-CHEMICAL TREATMENT  
SYSTEM UPGRADED TO MEET STATE  
EFFLUENT STANDARDS

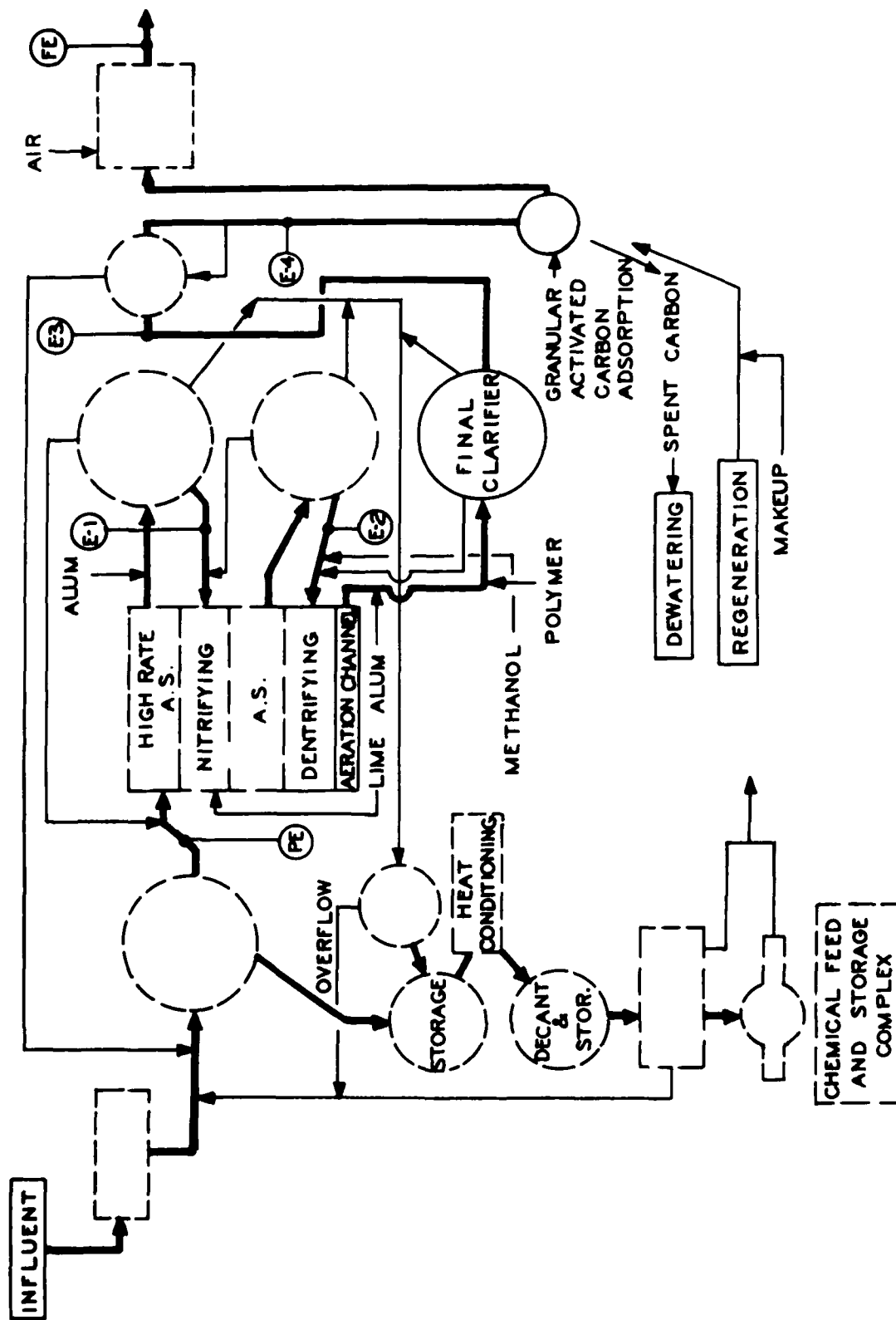
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NOTE  
 TOD = 1.5 (BOD<sub>5</sub>)  
 + 4.6 (N<sub>T</sub> - N<sub>H</sub>)

TOTAL LIME DOSE = 410 mg/L AS Ca(OH)<sub>2</sub>

FIGURE 6A  
 BASIC PHYSICAL-CHEMICAL TREATMENT  
 SYSTEM UPGRADED TO MEET STATE  
 EFFLUENT STANDARDS:  
 PROCESS PERFORMANCE A.3.4



**FIGURE 7**  
**BASIC BIOLOGICAL TREATMENT SYSTEM**  
**UPGRADED TO MEET FEDERAL EFFLUENT**  
**STANDARDS**

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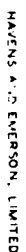
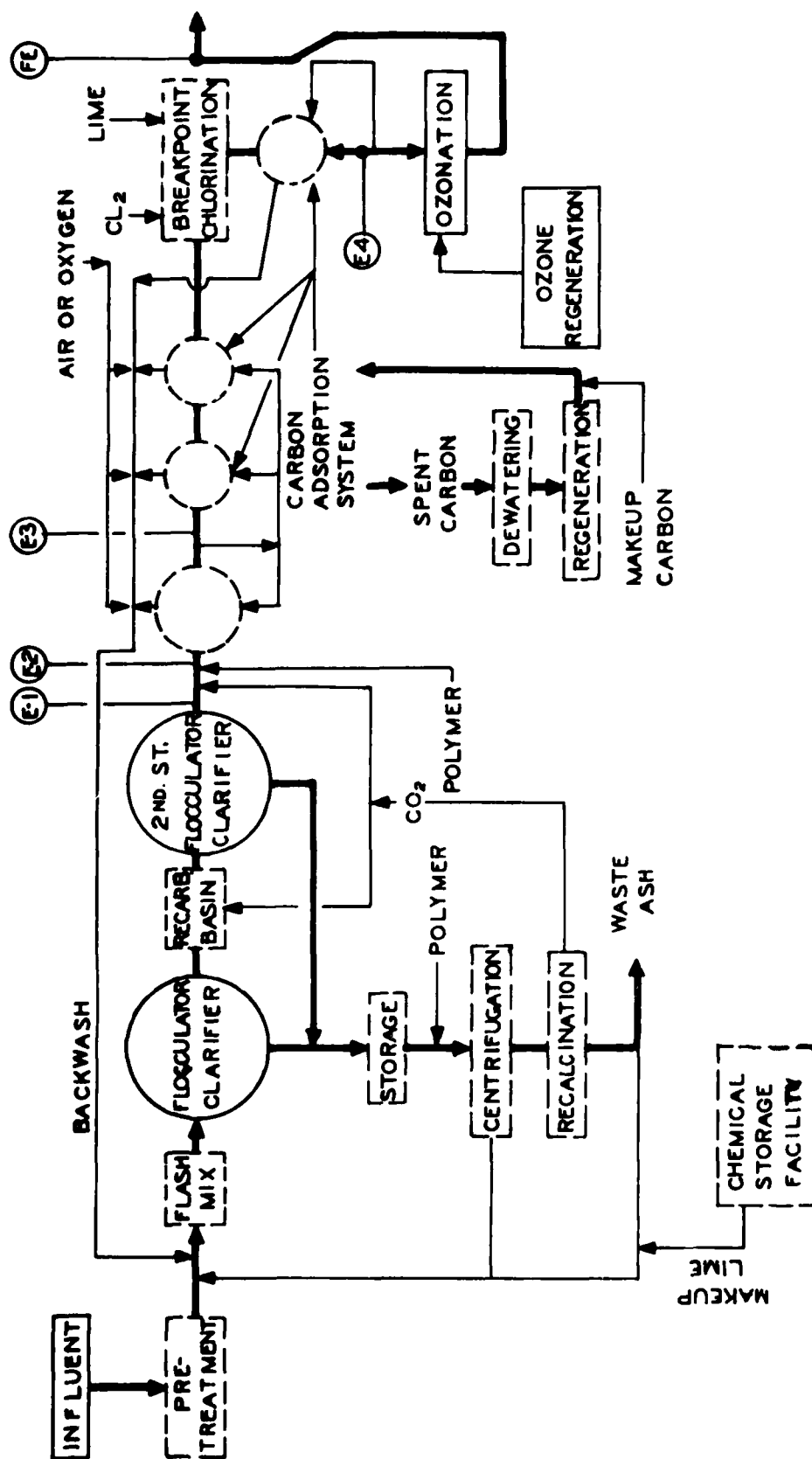


FIGURE 7A  
BASIC BIOLOGICAL TREATMENT SYSTEM  
UPGRADED TO MEET FEDERAL EFFLUENT  
STANDARDS PROCESS PERFORMANCE



**FIGURE 8**  
**BASIC PHYSICAL-CHEMICAL**  
**TREATMENT SYSTEM**  
**UPGRADED TO MEET FEDERAL**  
**STANDARDS**  
**FFFLUENT**  
**A37**

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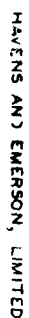
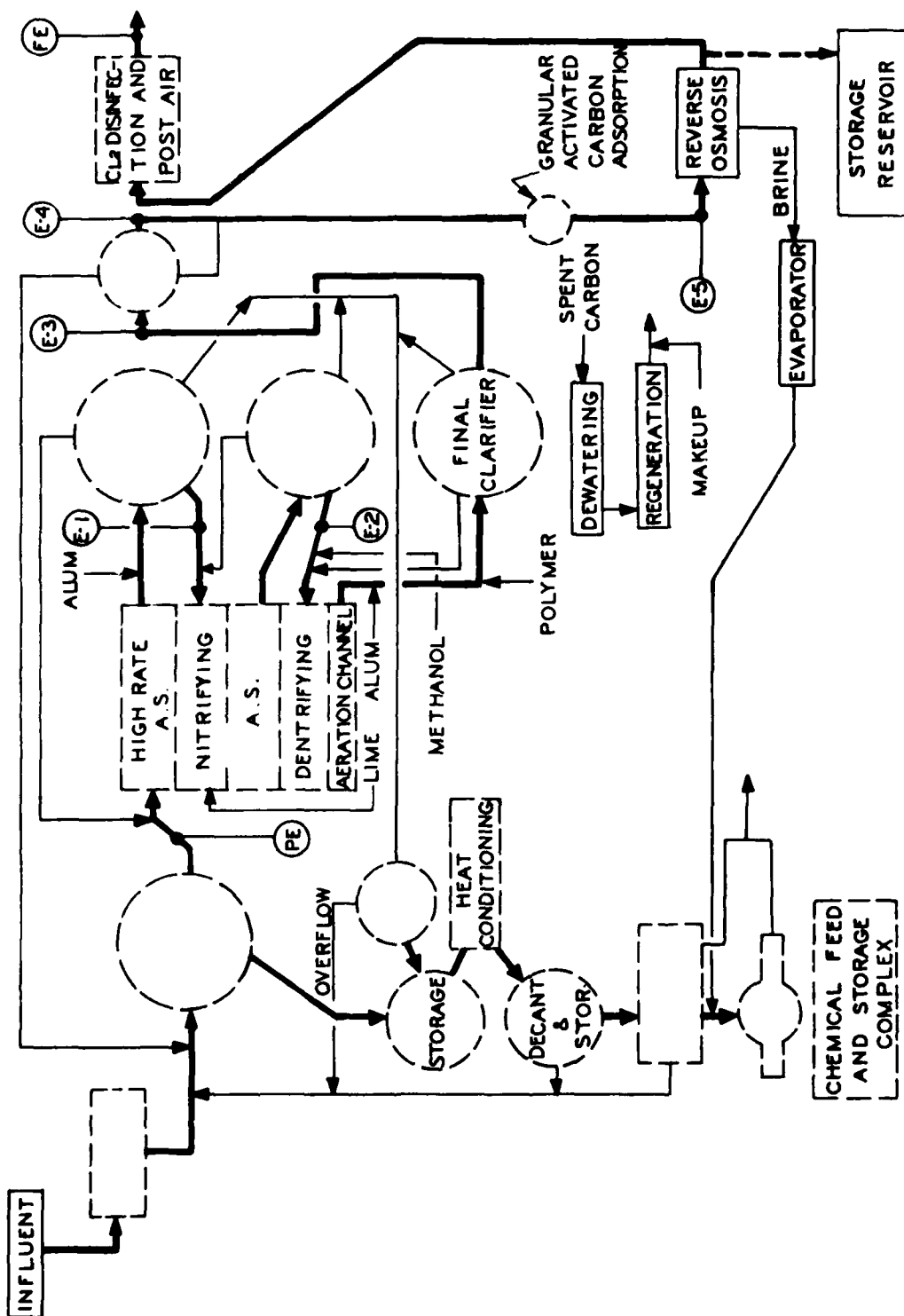


FIGURE 8A  
BASIC PHYSICAL-CHEMICAL  
TREATMENT SYSTEM  
UPGRADED TO MEET FEDERAL EFFLUENT  
STANDARDS: PROCESS PERFORMANCE



**FIGURE 9**  
**BASIC BIOLOGICAL TREATMENT SYSTEM**  
**UPGRADED FOR ULTIMATE REUSE**  
**APPLICATIONS**

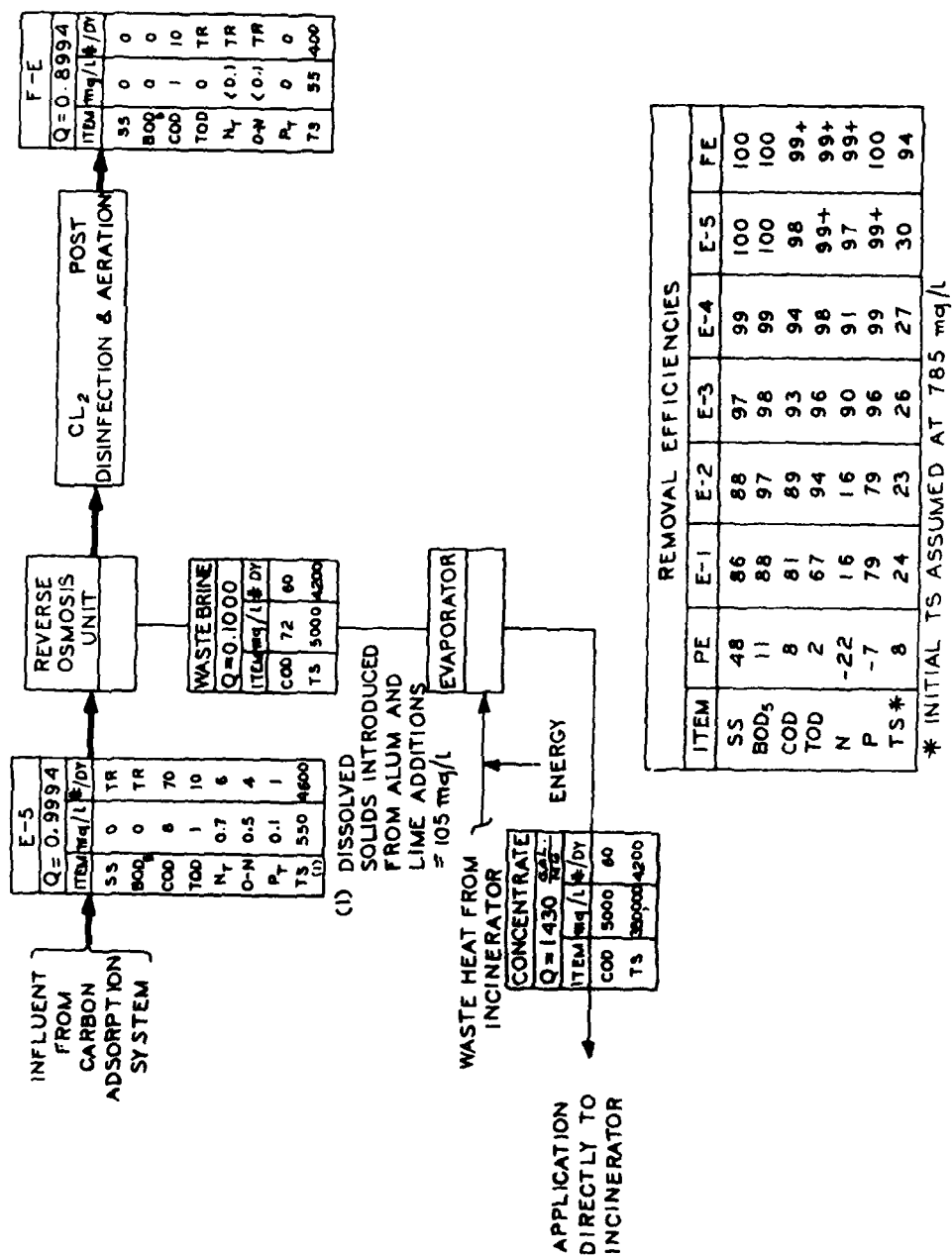
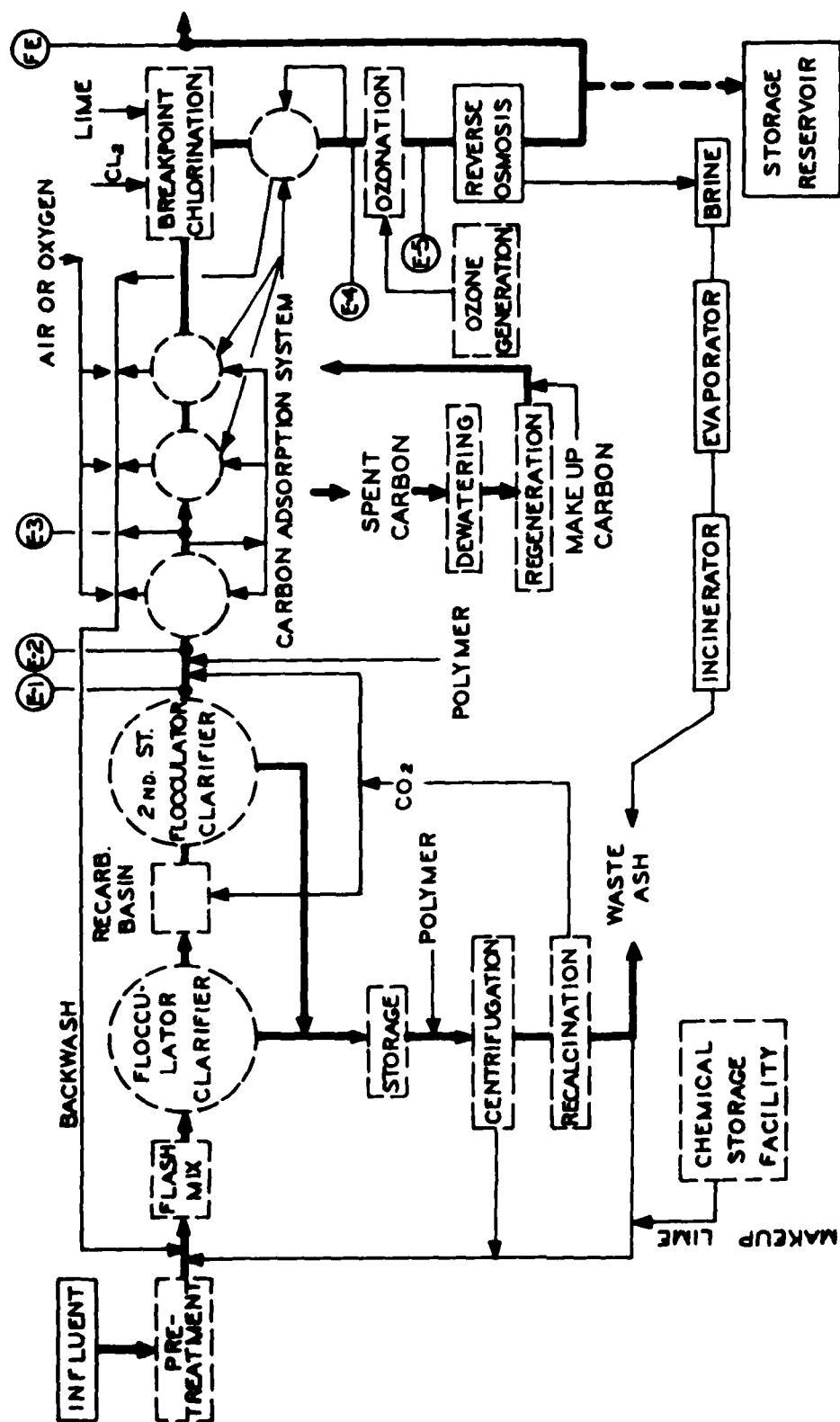
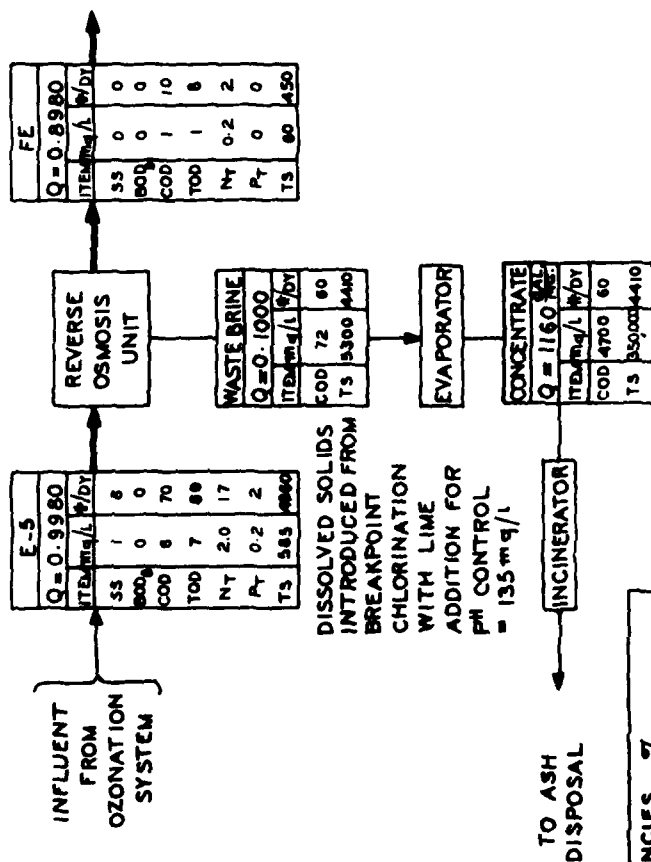


FIGURE 9A  
BASIC BIOLOGICAL TREATMENT SYSTEM  
UPGRADED FOR ULTIMATE REUSE  
APPLICATIONS: PROCESS PERFORMANCE



**FIGURE 10**  
**BASIC PHYSICAL-CHEMICAL TREATMENT**  
**SYSTEM UPGRADED FOR ULTIMATE REUSE**  
**APPLICATIONS**



ITEM	REMOVAL EFFICIENCIES %					FE
	E-1	E-2	E-3	E-4	E-5	
SS	89	95	99	99	99+	100
BOD <sub>5</sub>	74	74	76	97	100	100
COD	51	51	52	96	98	99+
TOD	61	61	62	96	98	99+
NT	28	28	29	91	91	99+
P <sub>T</sub>	90	90	95	98	98	100
TS*	22	22	23	21	21	92

\* INITIAL TS ASSUMED AT 785 mg/l

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FIGURE 10A

BASIC PHYSICAL-CHEMICAL TREATMENT SYSTEM UPGRADED FOR ULTIMATE REUSE APPLICATIONS: PROCESS PERFORMANCE

## 2. DESIGN CRITERIA

Design criteria were established for various basic elements of a wastewater management program for use in the preliminary design development of the alternative plans.

### 2.1 DEFINITION OF FLOW TERMS

A definition of flow related terms is provided followed by a description of the design criteria.

Dry weather flow (DWF) is defined as the flow received at the plant on days when no precipitation occurs, and when antecedent runoff is not affecting flow materially.

Average Daily Flow (ADF) is defined as the total annual flow received divided by 365 days. ADF includes ground water infiltration and certain amounts of storm water infiltration and is the value normally used in the sanitary engineering profession as the average design flow for treatment units.

Maximum Flow (MF) is defined as the peak hourly flow rate accepted for full treatment.

Maximum Daily Flow (MDF) is defined as the highest 24 hour flow received during a year.

Maximum Hourly Flow (MHF) is the flow received in the maximum hour in a day and represents the peak diurnal flow.

The above values are related as follows:

ADF = 1.1 to 1.2 x DWF	Use: 1.15 x DWF
MDF = 1.4 to 1.7 x ADF	Use: 1.50 x ADF
MF = 2.5 ADF = 2.9 DWF	Use: 3.00 x DWF
MF = 1.35 x MDF = 1.35 x 1.6 x ADF	Use: 2.50 x ADF
MHF = 1.2 to 1.5 ADF	Use: 1.35 x ADF

### 2.2 MUNICIPAL TREATMENT PLANTS

The design criteria for the conventional activated sludge plant, the advanced biological treatment plant, and the physical chemical plant are

discussed in detail in the previous section of this report. The conventional activated sludge plant and the advanced biological plants were considered to have a useful life of 35 years. The physical chemical treatment plants were considered to have a useful life of 25 years.

In calculating these useful lives, the following rational using a weighted average was employed:

ADVANCED BIOLOGICAL SYSTEM:

<u>Component</u>	<u>Useful Life</u>	<u>Percent of Plant Cost</u>
pretreatment and primary unit	45 years	33.3
secondary, denitrifications and nitrification unit	40 years	33.3
tertiary units	<u>20 years</u>	<u>33.3</u>
weighted average	35 years	

PHYSICAL CHEMICAL SYSTEM:

phosphorous removal, coagulation sedimentation	40 years	25
carbon adsorption, breakpoint chlorination ozonation	<u>20 years</u>	<u>75</u>
weighted average	25 years	

### 2.3 LOADING RATIOS

In a treatment process, the various units are designed for both a hydraulic and pollutant mass loading greater than that of the average daily flow. Likewise, components of the unit process itself are designed with different loading factors. Generally, those unit processes such as sedimentation and physical separation are more dependant upon hydraulic loading whereas the biological-chemical reactors are more dependant upon pollutant mass loading.

The following statements define the loading ratios for the advanced

biological systems. For a physical-chemical system, the carbon absorption ration would be 1.5 times the average daily flow.

Preliminary, primary and secondary treatment:

Design criteria will be based on ADF with higher loadings permitted at MF. We therefore expect variations in effluent quality in the range of 20-30 mg/l BOD and SS, through the secondary treatment stage.

Mixed Media Filtration:

Secondary treatment has a definite buffering effect, and the process effectiveness is related to solids loading as well as flow rate.

Design Rates: ADF = 2.0 gpm/s.f.

MF = 5 gpm/s.f.

Biological Nitrification and Dentrifications:

These processes are nitrogen mass and temperature dependent and are partly effected by detention time. Use conservative design rates:

Nitrification: ADF = 6 hours detention	MF = 4 hours
Denitrification: ADF = 3 hours detention	MF = 2 hours
Carbon Adsorption: MF = 1.0 x ADF	

Carbon adsorption when it follows filtration (as assumed herein) is primarily dependent upon dissolved organic concentration. Flow variations when following biological stabilization have minor effect. Design based on 3-4 gpm/s.f. 15 minute contact at MF.

Reverse Osmosis:

The reverse osmosis process is dependent upon flux rate, but the process is capable of exceeding the standards established on some

constituents. For study purposes, a constant flow rate can be assumed at ADF, with maximum flow increments by-passed in a split flow process.

#### 2.4 PUMP STATIONS

Sewage pumping stations must be evaluated based upon average flow conditions. The pumping station, however, should be sized greater than the average flow to account for variations in sewage flow and standby capacity for mechanical failures. For an average flow of 1 mgd (approximately 10,000 people) or less total standby has been provided. For an average flow of greater than 1 mgd, 1/2 standby has been provided. In all cases firm capacity is provided for peak flows with the largest unit out of service. The need for greater standby capacity in the smaller pump stations is due to the greater variation in average to peak flows. Cost estimates include provision of diesel-electric standby power generation.

Sewage pumping stations are generally designed for a 20 year design period.

The pumping station power costs have been based on a pump efficiency of 75%, the appropriate pumping head, and a power cost of 1.21¢ per KWH.

#### 2.5 GRAVITY SEWERS

In determination of sewer slopes, profiles were taken from U.S.G.S. 1:24000; topographic maps. Pipe sizes were based on these slopes and the resulting discharges from population and flow projections. A peaking factor was applied to the average discharge. The peaking factor used was curve A in figure 4 of the American Society of Civil Engineers manual number 37. This curve has been verified in the Northeast Ohio area by previous studies done by Havens and Emerson. The minimum allowable velocity for 1970

minimum flows was 1.5 feet per second. The maximum allowable velocity for peak flows was 10 feet per second. The desired velocity was 3-6 feet per second. The minimum and maximum trench depths were 10 feet and 30 feet, respectively. For depths greater than 30 feet, tunneling was assumed. Mannings' roughness coefficient of 0.015 was selected for concrete pipe flowing full.

The gravity sewers were designed based on 2020 design flows with a useful life of 50 years.

#### 2.6 FORCE MAINS

Force mains were designed for maintaining velocities between 4 and 6 feet per second. The discharges were based on population and flow projections. Force mains have a minimum cover of 5 feet except for any required tunneling. Cast iron pipe was considered for lines less than 24-inches in diameter and reinforced concrete pressure pipe was considered for lines 24-inches and larger in diameter. The roughness coefficient varies depending upon the character of the liquid (sludge or sewage) pumped and the pipe material. A minimum pipe diameter of 8-inches was established.

Force mains were designed based on 2020 design flow with a useful life of 50 years.

#### 2.7 OUTFALL SEWERS

Outfall sewers were based on maintaining velocities of 2 to 4 feet per second. The outlet location was placed in at least 15 feet of water. Reinforced concrete pipe was used with a minimum diameter of 18 inches.

Outfall sewers were designed for 2020 design flows.

### 3. UNIT COSTS

Table 3 lists the wastewater treatment methods for which capital construction costs and operation and maintenance costs have been developed. These costs were developed for use in preparation of cost estimates for the alternative plans with an ENR construction index of 1740. Capital costs reflect the construction cost with no contingency allowance, except for the gravity sewer and force main cost which include 25% for contingencies. For the estimates construction costs without contingencies were used.

The capital costs are expressed in either Dollars per MGD of plant size (MGD) or Dollars per Dry Ton per Day of sludge facility size versus plant size (MGD) or sludge facility size (Dry Tons per Day), respectively. The operation and maintenance costs are expressed in either Dollars per MG of wastewater treated or Dollars per Dry Ton of sludge treated plant size (MGD) or sludge facility size (Dry Tons per Day), respectively. Plant size (MGD) is based on average daily flow. The reference numbers follow the process being discussed with the references listed in appendix A.

TABLE 3  
WASTEWATER TREATMENT UNIT COSTS  
FIGURE IDENTIFICATION

	<u>Capital Cost</u>	<u>O&amp;M Cost</u>
Activated Sludge with Primary	11	11A
Phosphorus Removal	12	12A
Chlorination	13	13A
Ozonation	14	14A
Nitrification	15	15A
Denitrification	16	16A
Coagulation and Sedimentation	17	17A
Microstrainers	18	18A
Mixed Media Filters	19	19A
Carbon Adsorption	20	20A
Breakpoint Chlorination	21	21A
Sludge Thickener	22	-
Sludge Digestion	23	23A
Heat Treatment	24	24A
Vacuum Filter	25	25A
Incineration	26	26A
Pump Station	27	27A
Gravity Sewer - Urban	28	-
Gravity Sewer - Rural	29	-
Force Main	30	-
Tunnel	31	-
Deep Tunnel	32	-

Following is a brief description of these methods to identify assumed design parameters and cost data references.

Activated sludge with Primary - Figures 11 and 11A represent the total capital cost and operation and maintenance cost for a conventional activated sludge plant including preliminary treatment, primary settling tanks, aeration tanks, (4.5 to 6 hours contact time), final settling tanks, blower building, and administration and laboratory facilities. These curves do not reflect any costs for sludge handling. Ref. \* 1,4,5,8,19

Phosphorus Removal - Figures 12 and 12A represent the total capital

\*For cost data sources see References, Appendix A.

cost and operation and maintenance cost for phosphorus removal accomplished through metal salt addition to the aerator effluent. Chemical feed facilities and housing are the only required capital expenditures. Ref. 4,15

Chlorination - Figures 13 and 13A represent the total capital cost and operation and maintenance cost for chlorination of plant effluent. A 30 minute contact time at average flow with a chlorine residual of 0.5 mg/l was the basic design criteria. Ref. 1,8,19,17

Ozonation - Figures 14 and 14A represent the total capital cost and operation and maintenance cost for ozonation. Costs have been computed for various dosage concentrations to illustrate the cost fluctuations. It was assumed that 5 mg/l was adequate for disinfection and 20-30 mg/l was adequate for COD removal. Ref. 9,11

Nitrification - Figures 15 and 15A represent the total capital cost and operation and maintenance cost for nitrification. This is accomplished through modification of the conventional activated sludge plant with a 1/3 - 2/3 volumetric split of the existing aerator which results in a nitrifying contact time of 3 to 4 hours. A new final clarifier is required to allow the complete separation of the two distinct biological cultures. The capital cost therefore assumes addition to a conventional activated sludge plant. Ref. 10,14

Denitrification - Figures 16 and 16A represent the capital cost and operation and maintenance cost for denitrification. This includes a denitrification reactor, (3 hours detention) an aerated channel, and an additional final clarifier. Ref. 10

Coagulation and Sedimentation - Figures 17 and 17A represent the capital cost and operation and maintenance cost for coagulation and sedimentation after lime addition. This is a two stage treatment consisting of a flash

mix chamber, and a flocculator-clarifier basin followed by recarbonation and a second stage flocculator-clarifier. The lime recovery and reuse system includes lime mud dewatering, a recalcination reactor and slaker. Ref. 1,4,15,19

Microstrainers - Figures 18 and 18A represent the capital cost and operation and maintenance cost for microstraining of secondary effluent. Maximum hydraulic loadings were assumed between 600-800 gal/sq.ft./hr., with a Mark I (35 micron fabric) screen. Ref. 1,4,16

Mixed Media Filters - Figures 19 and 19A represent the capital cost and operation and maintenance cost for mixed media filters. Filter loading rates are based on a hydraulic loading of 2 gpm/sq.ft. for average daily flow. Ref. 1,4,16,3,18,19

Carbon Adsorption - Figures 20 and 20A represent the capital cost and operation and maintenance cost for carbon adsorption following filtration. The design is based on 3-4 gpm/sq.ft. and a contact time of 15 minutes for average daily flow. Included in this cost is regeneration of the spent carbon in a high temperature reactor. Ref. 1,4,12,18

Breakpoint Chlorination - Figures 21 and 21A represent the total capital cost and operation and maintenance cost for breakpoint chlorination. This cost includes a small contact chamber and facilities for the chemical feed equipment. For the physical chemical plant (Level 2) the dosage is 103 mg/l. For the stormwater treatment plant (Level 2) the dosage is 52 mg/l.

Sludge Thickeners - Figure 22 represents the total capital cost for gravity thickening of waste activated sludge. The design assumes a loading of four pounds/sq.ft./day. Ref. 1

Sludge Digestion - Figures 23 and 23A represent the total capital cost and operation and maintenance cost for sludge digester. The design assumes a 30 day detention period with a percent feed solids of 3.6. Ref. 1,5,18,12

Heat Treatment - Figures 24 and 24A represent the total capital cost and operation and maintenance cost for heat treatment. This design assumes a low pressure oxidation unit with allowances made for shift differential for various plant sizes. One shift for plants less than 10 mgd, two shifts for plants between 10-30 mgd, and three shifts for plants greater than 30 mgd. Ref. 6,2

Vacuum Filter - Figures 25 and 25A represent the total capital cost and operation and maintenance cost for vacuum filters. A loading rate of 4 lbs./sq.ft./hr. was assumed for digested sludge and 10 lbs./sq.ft/hr. for heat treated sludge. Allowances were also made for shift differentials for the same plant sizes as for heat treatment. Ref. 1,5,18,2

Incineration - Figures 26 and 26A represent the total capital cost and operation and maintenance cost for incinerating sludge filter cake. Allowances were also made for shift differentials for various plant size. Ref. 5,2

Pump Station - Figures 27 and 27A represent the total capital cost and operation and maintenance cost for pump station. Operation and maintenance costs are shown for total dynamic heads of 50, 100, and 200 feet. Ref. 4,5

Gravity Sewer - Urban and Rural - Figures 28 and 29 represent the total capital cost for gravity sewers for urban and rural areas, respectively. Each figure shows two curves to allow for different depths of cover. This cost includes sewer cost, excavation, backfill, pavement replacement and 25% for contingencies. The urban cost allows for utility protections, off site storage of excavated materials, and tighter working conditions.

Force Main - Figure 30 represents the capital cost for force mains. This cost includes pipe cost, excavation, backfill, allowances for pavement replacement, and 25% for contingencies.

Tunnel - Figure 31 represents the total capital cost for tunnel construction. This cost was used for river crossings, railroad crossings, and in certain instances in heavily urbanized areas.

Deep Tunnel - Figure 32 represents the total capital cost for deep tunnel construction in shale. The tunnel will be drilled using a shield type mining machine and lined with a minimum of 18 inches of reinforced concrete. Ref. 20

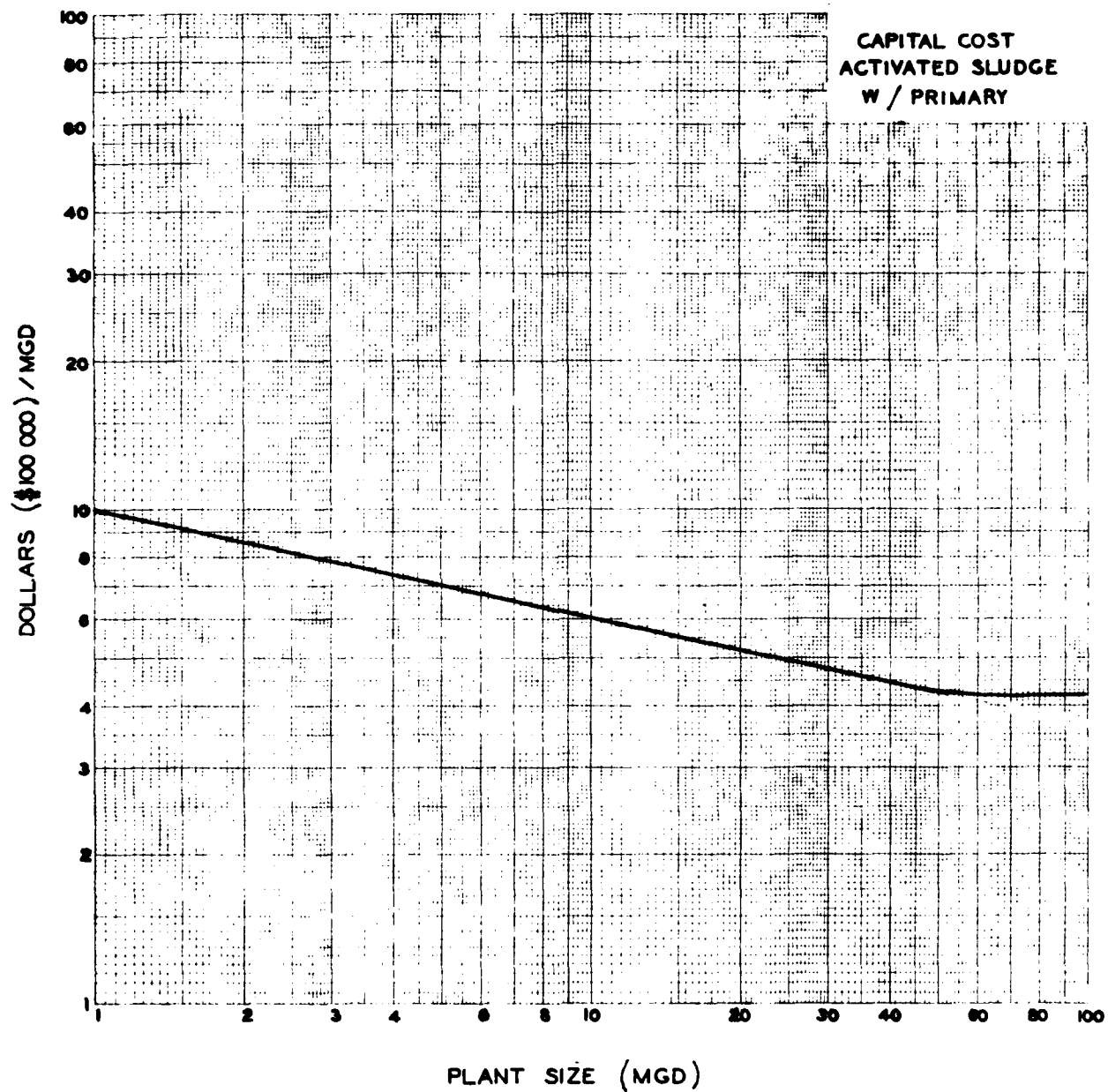


Figure No. 11

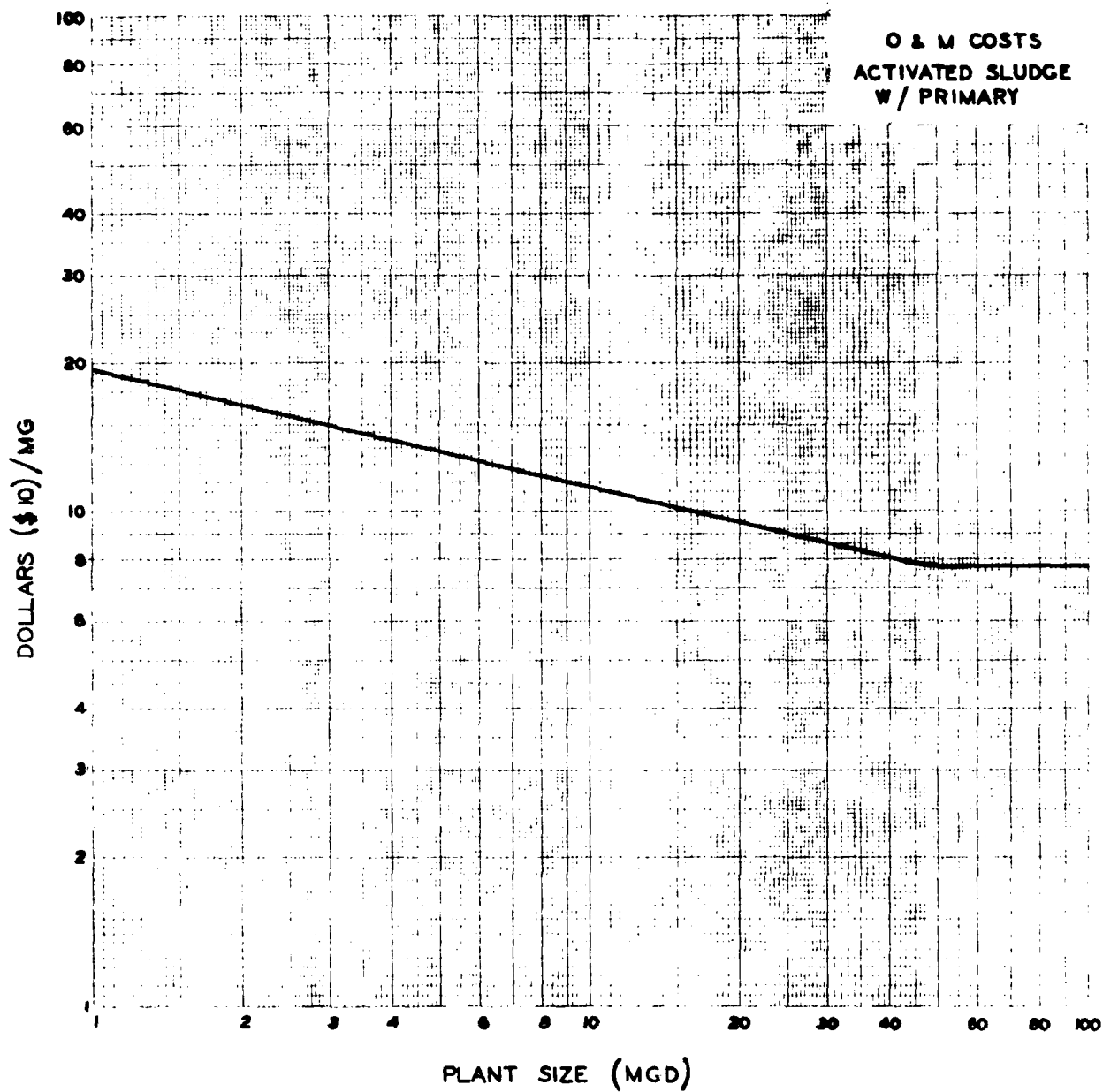


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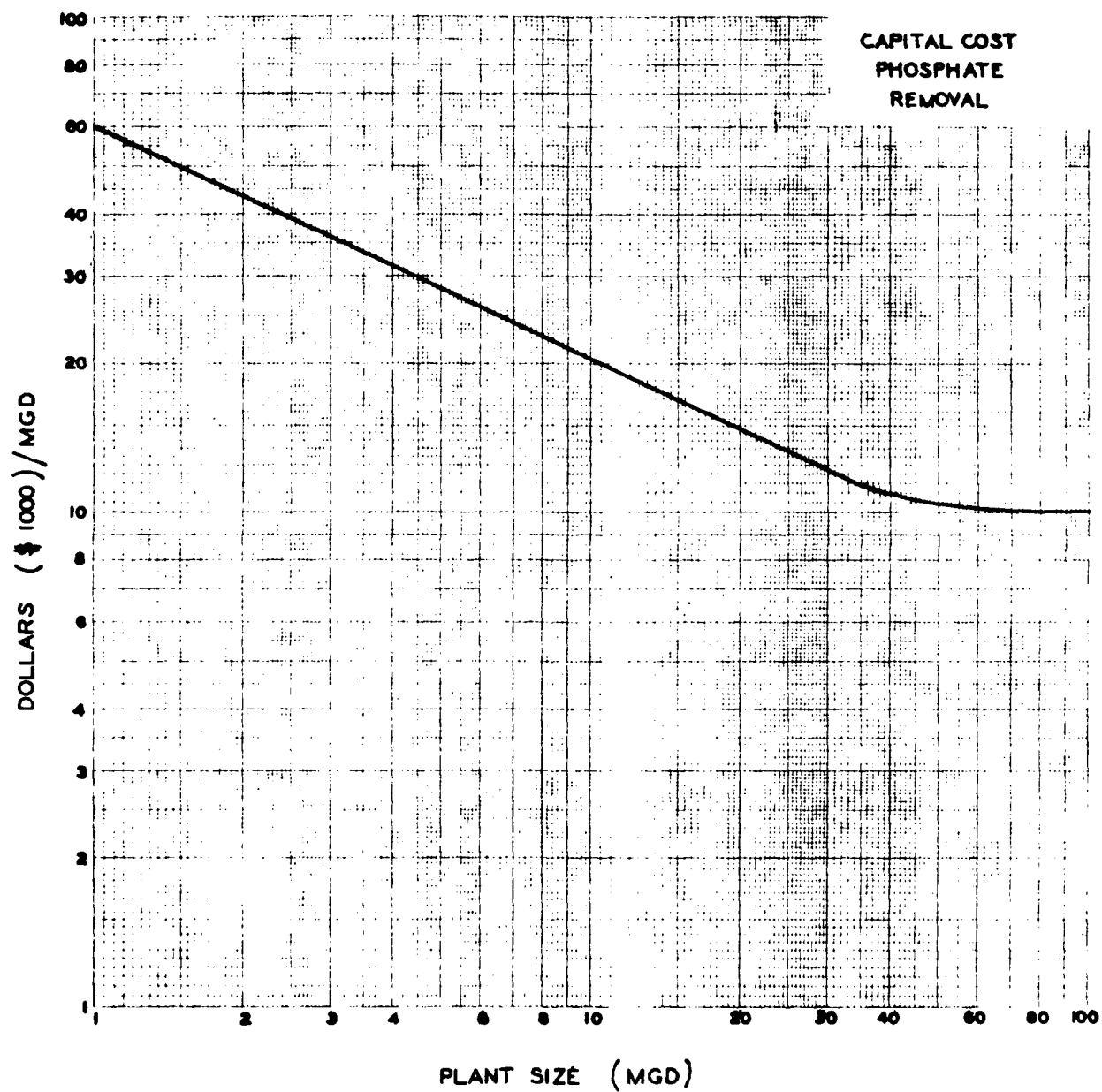


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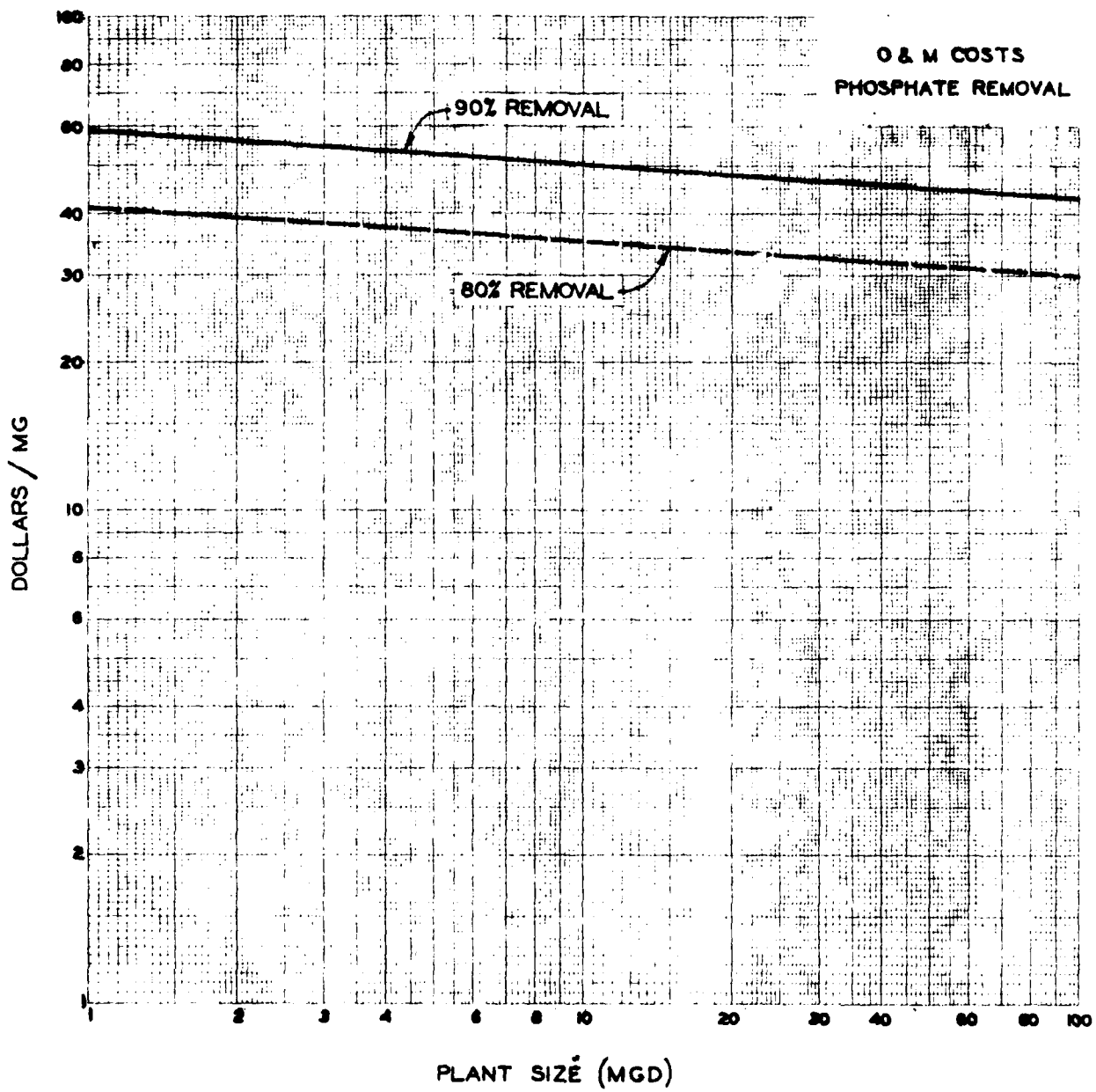


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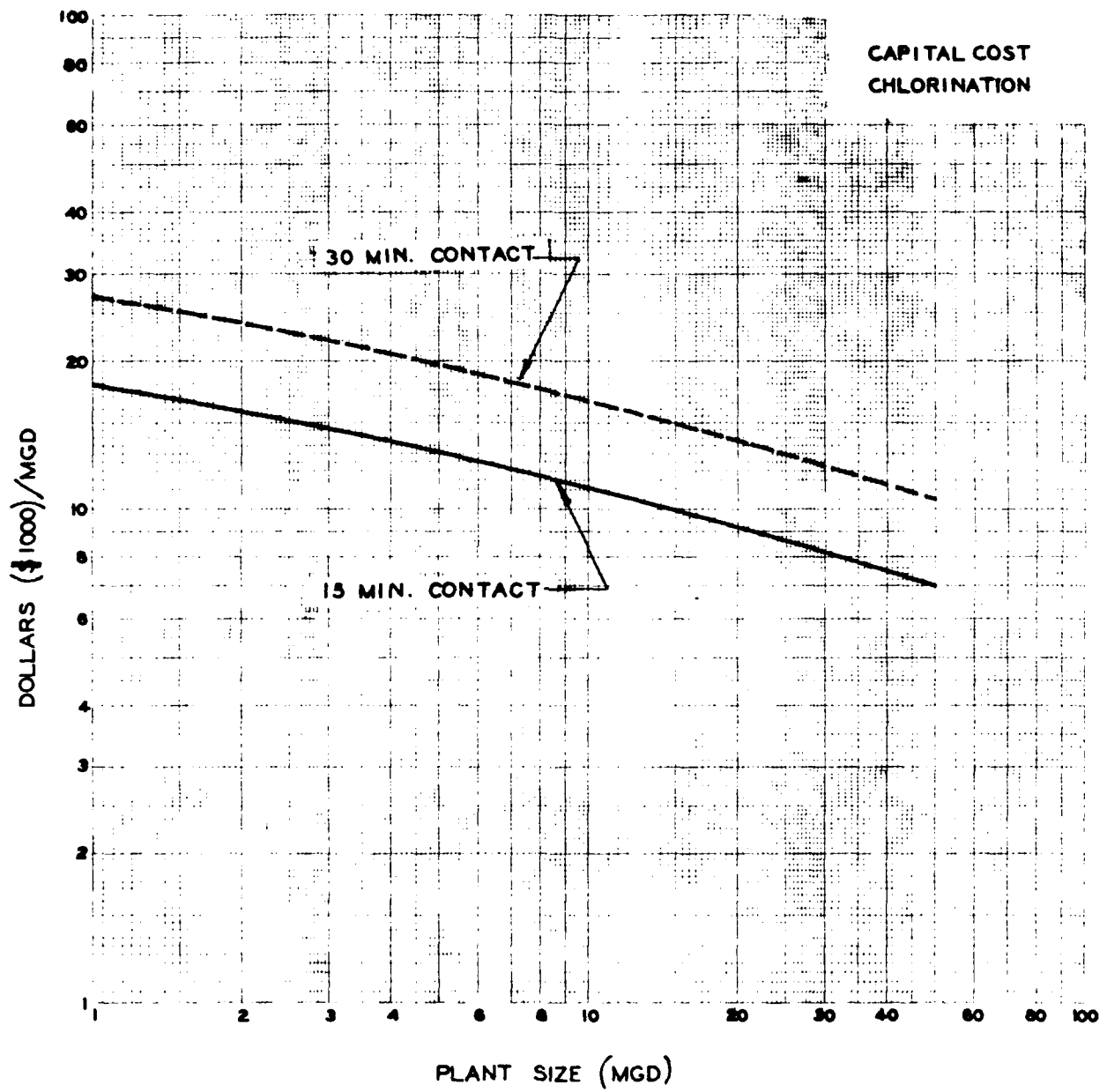


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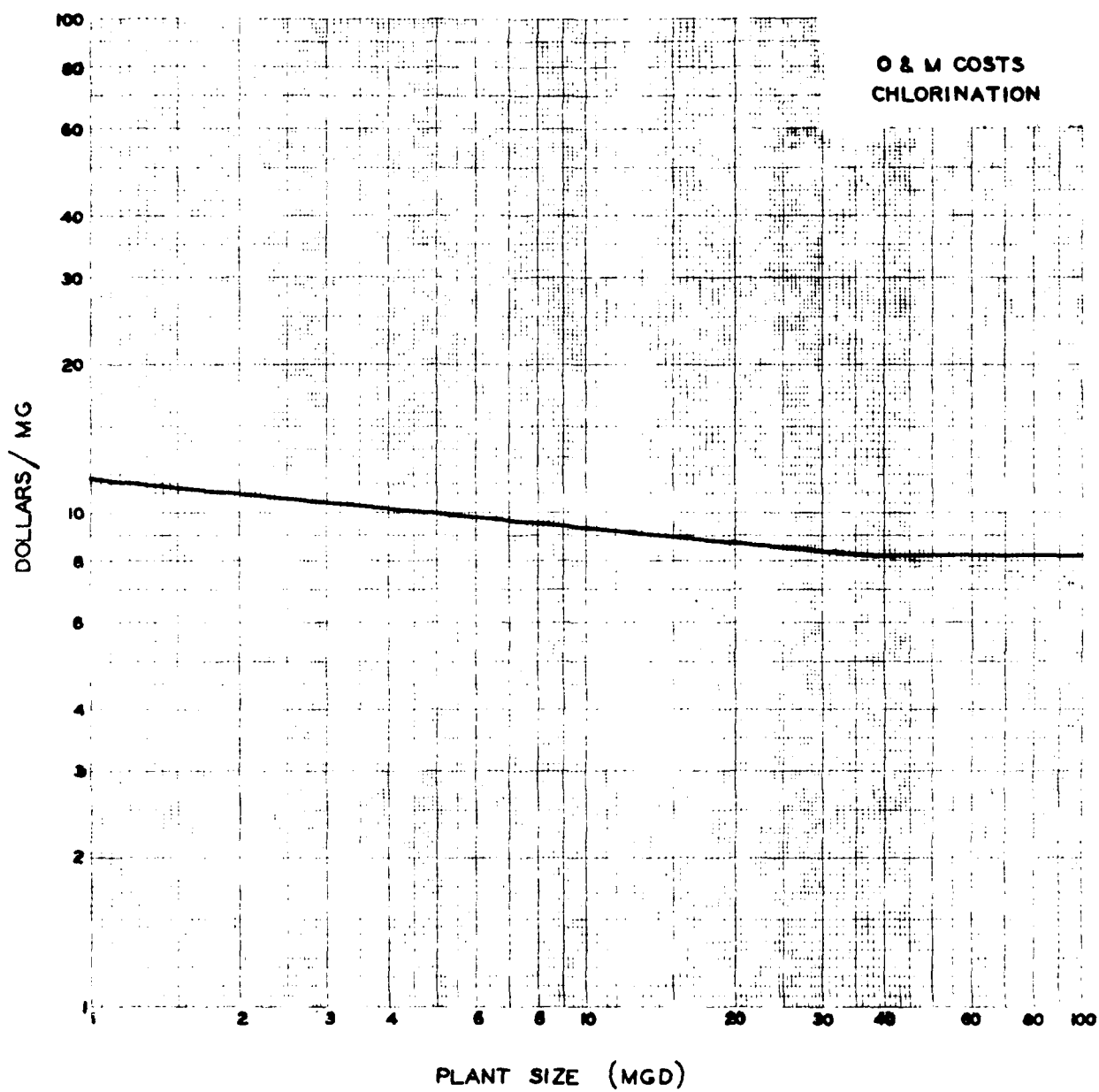


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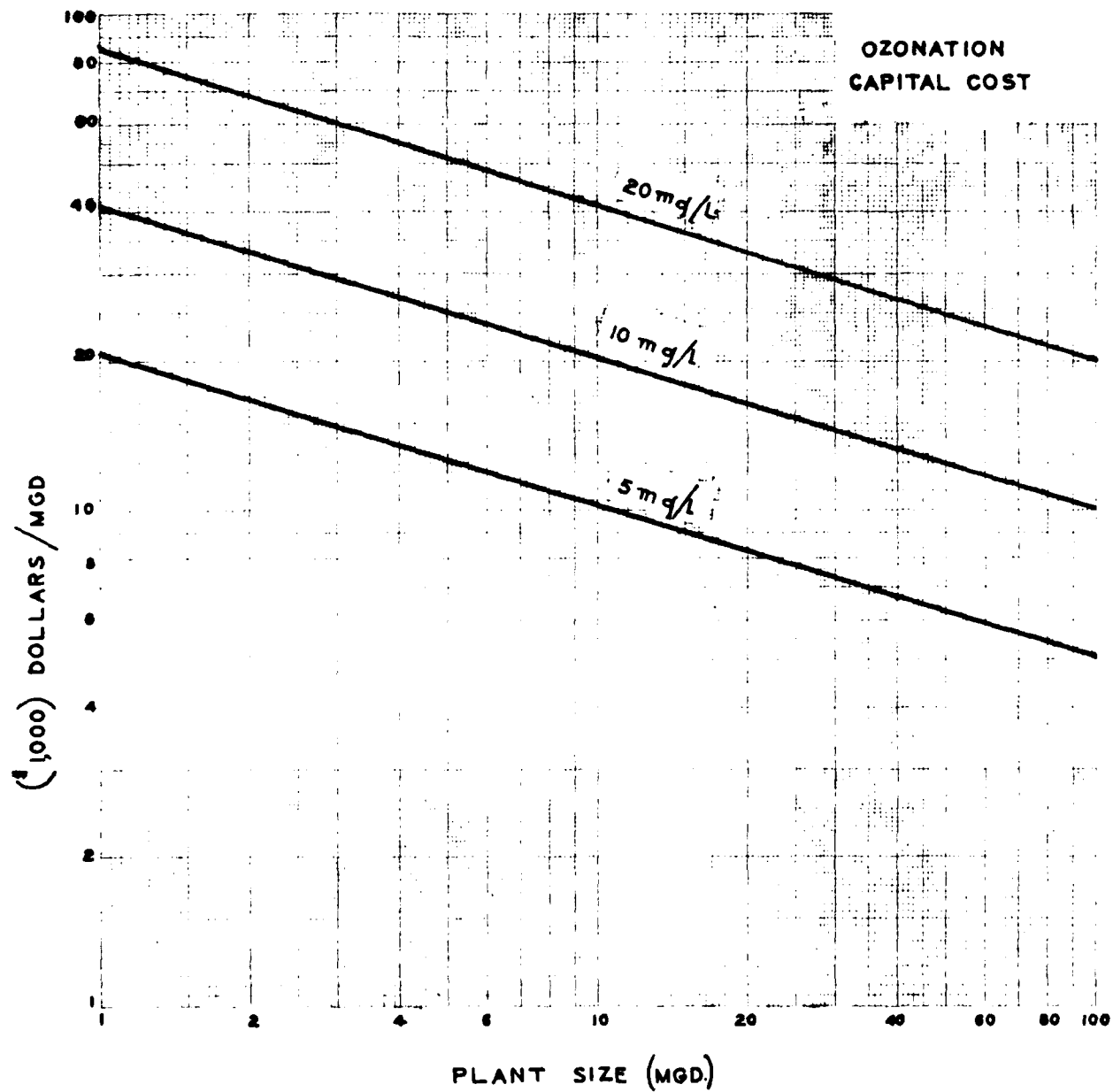


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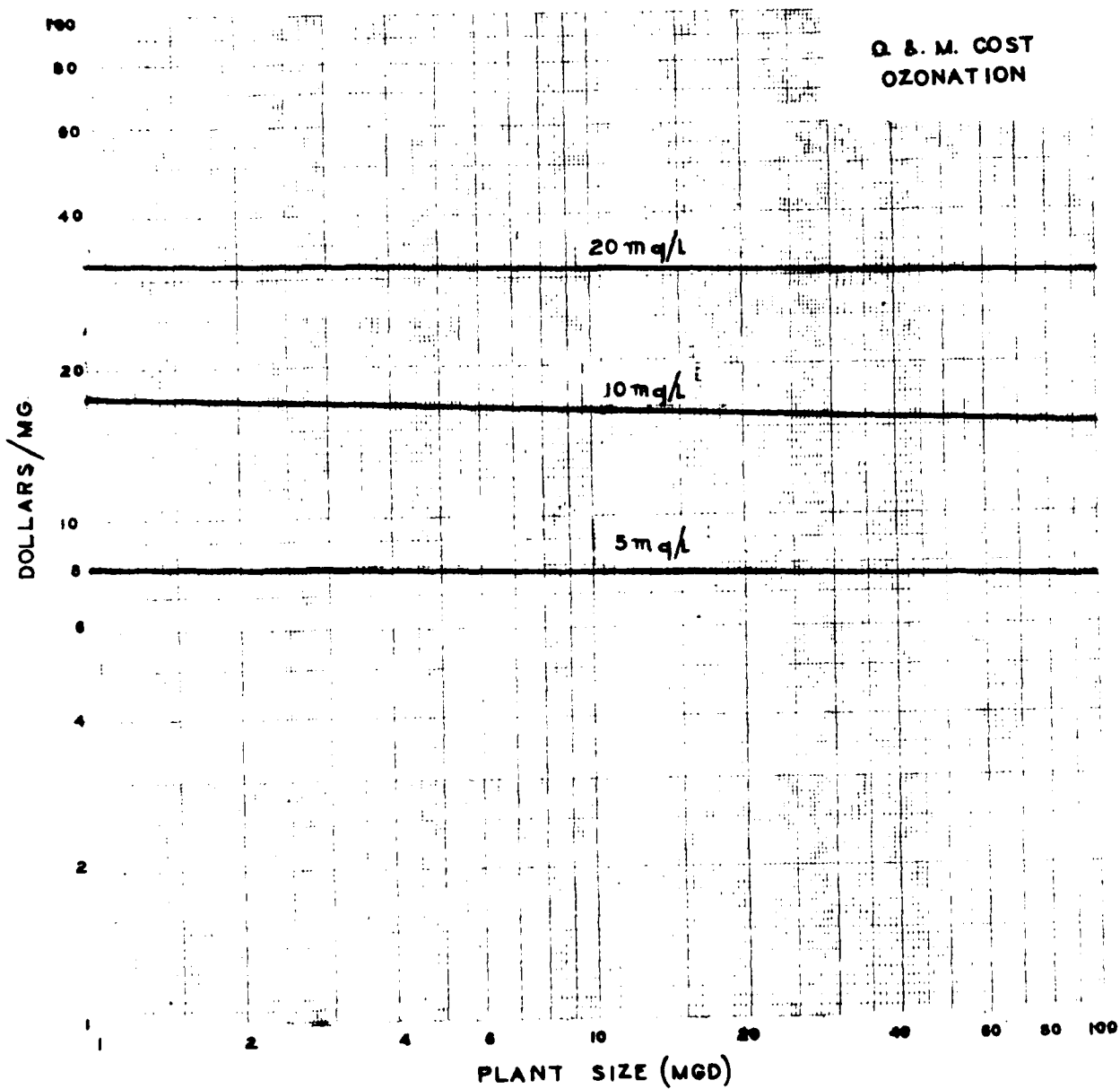


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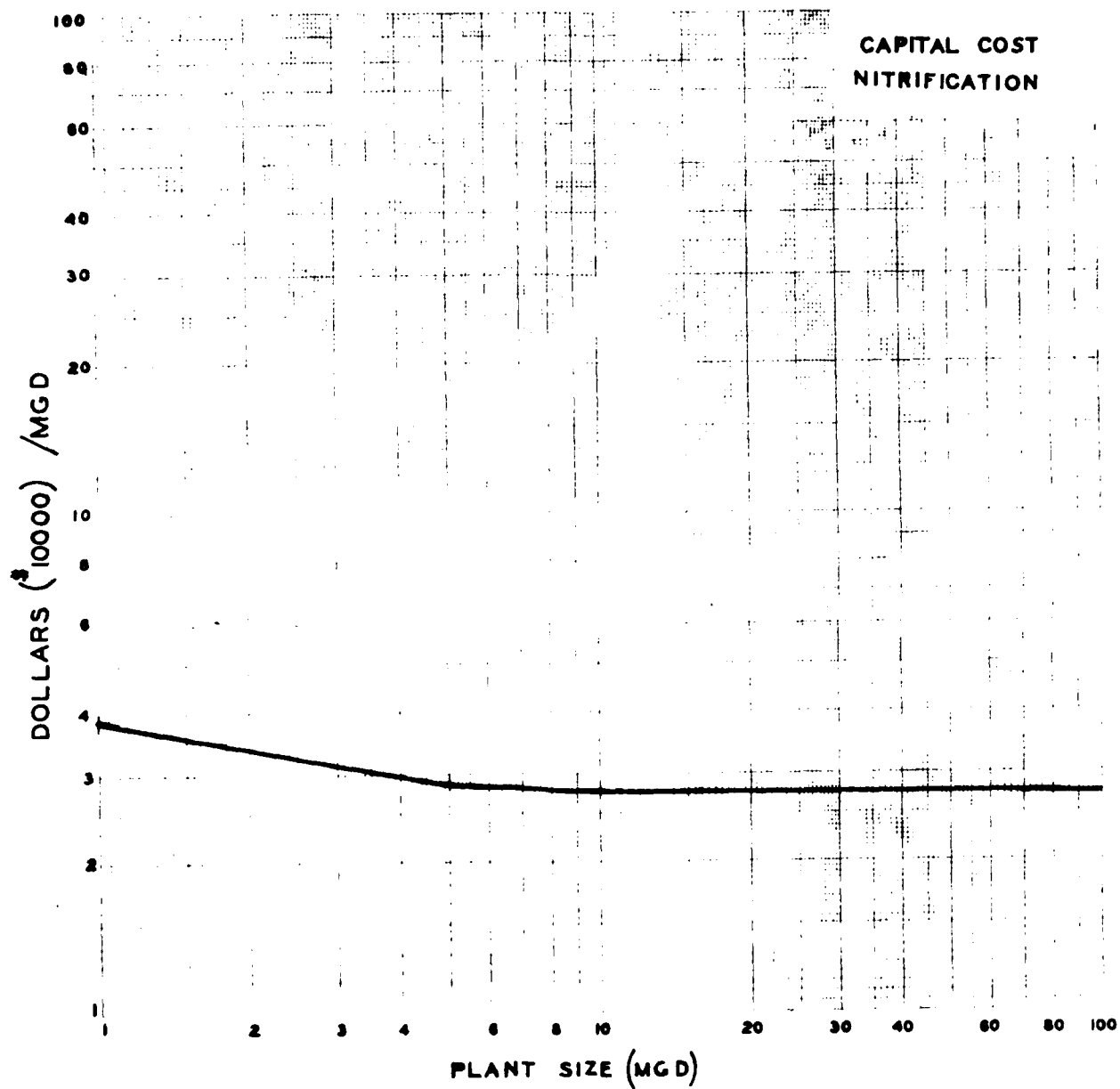


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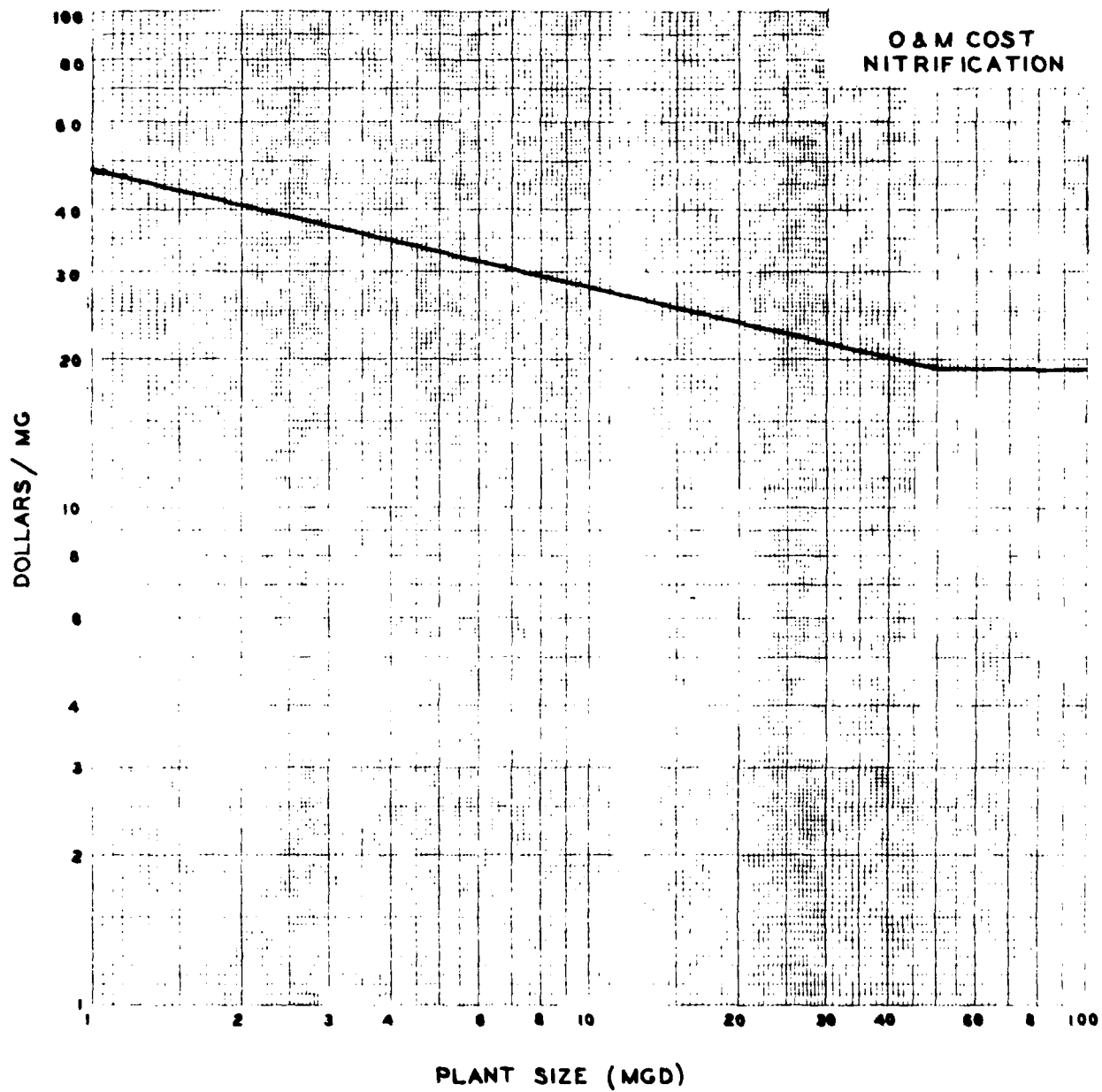


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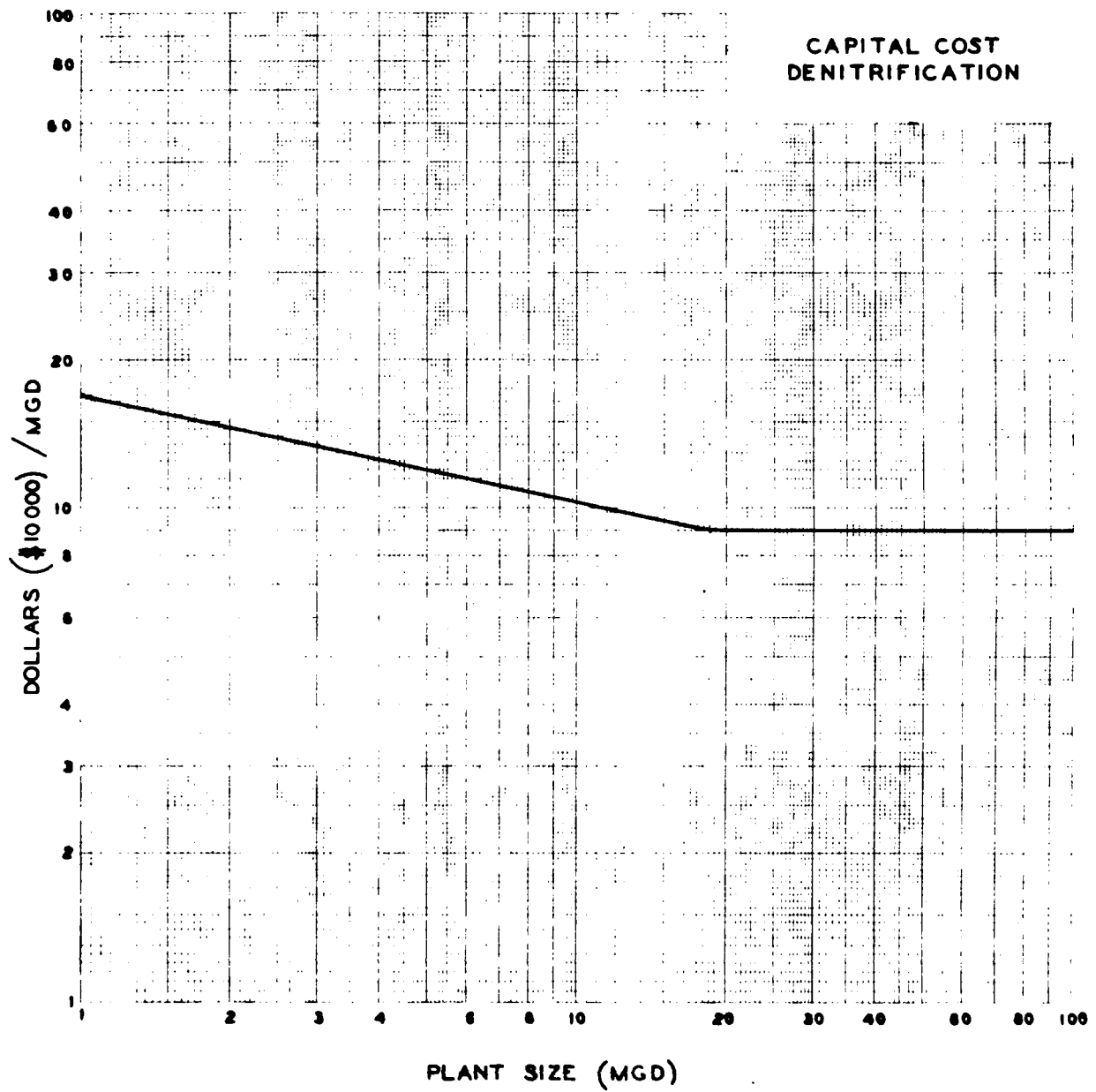


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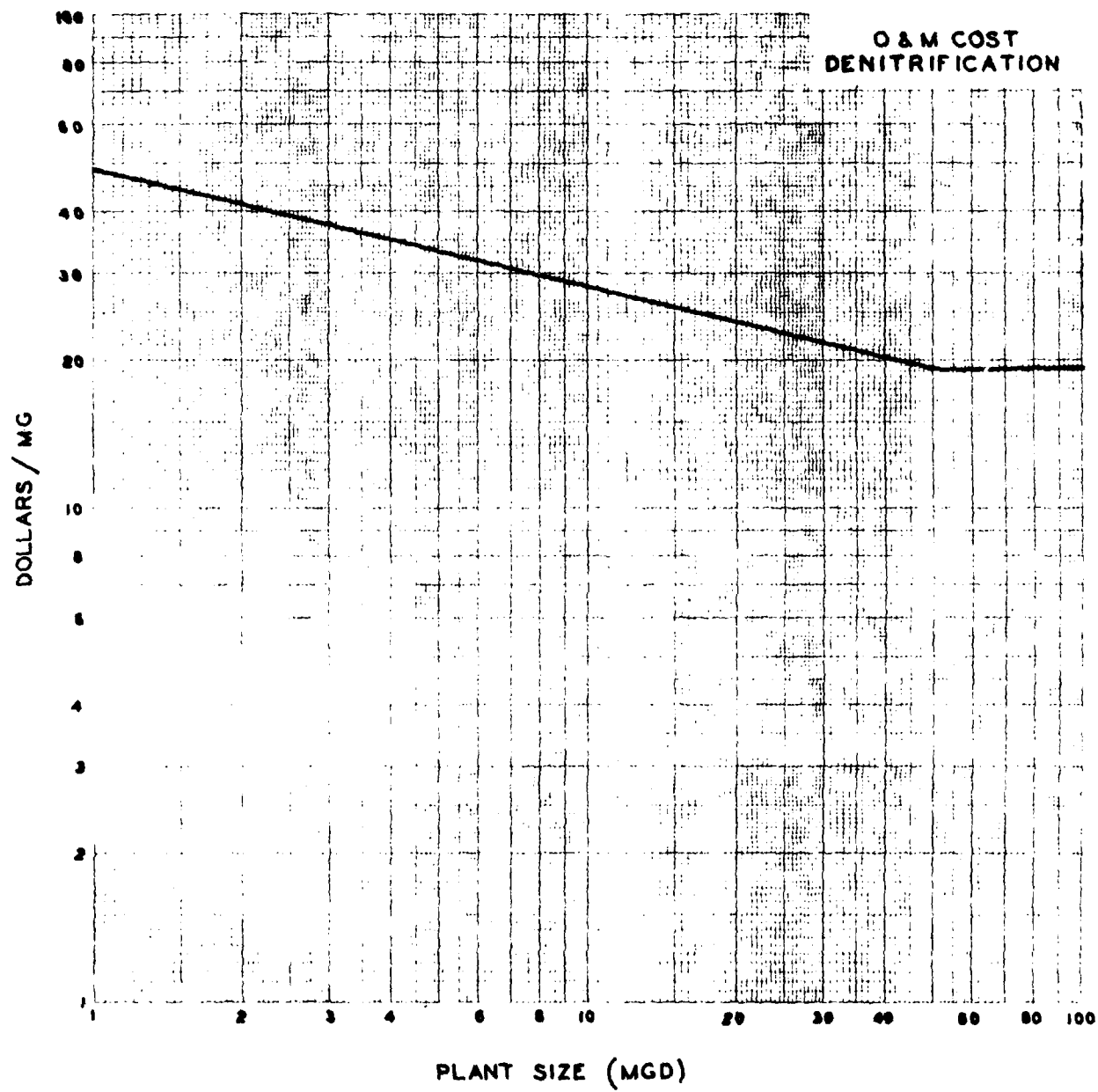


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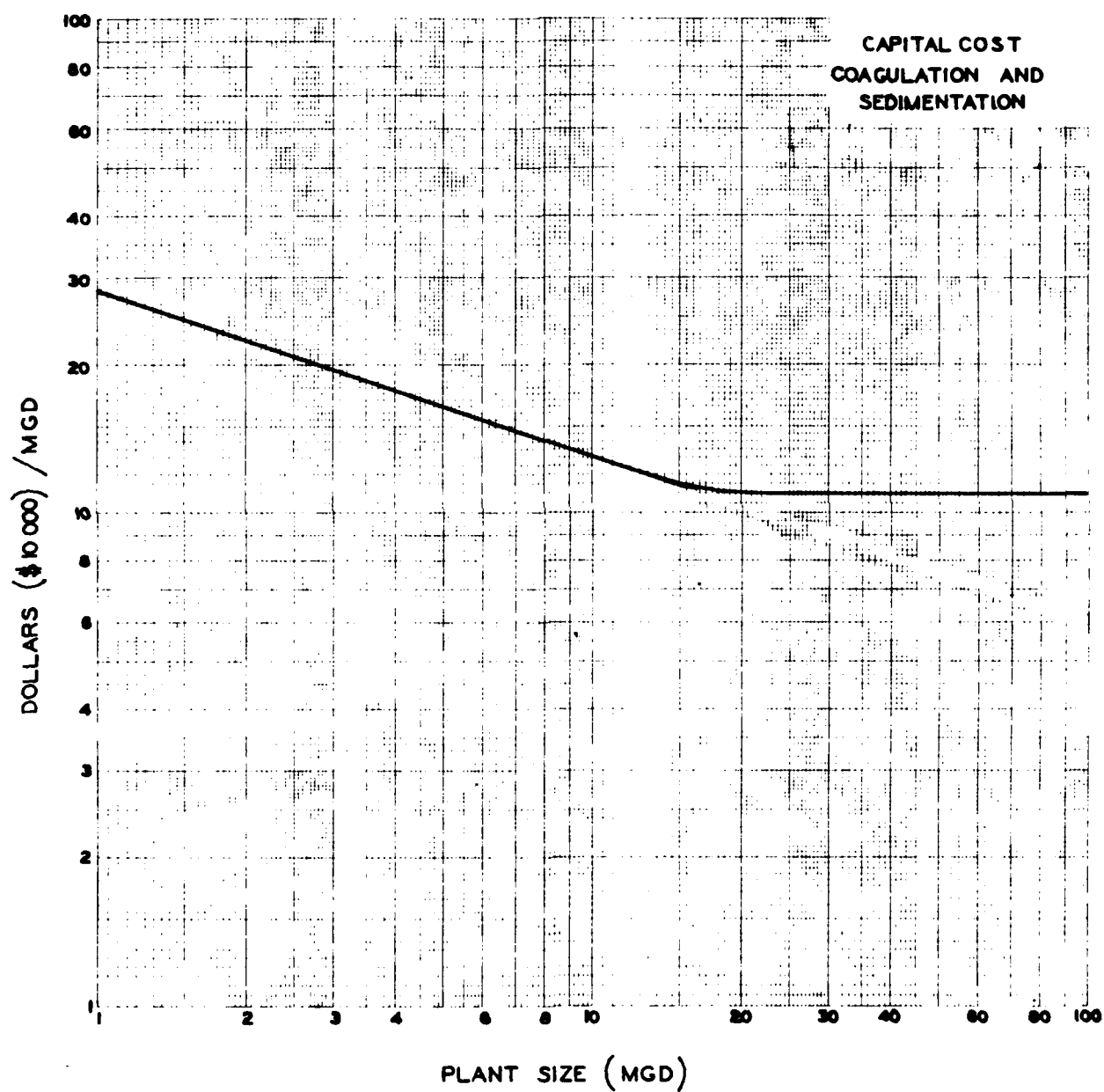


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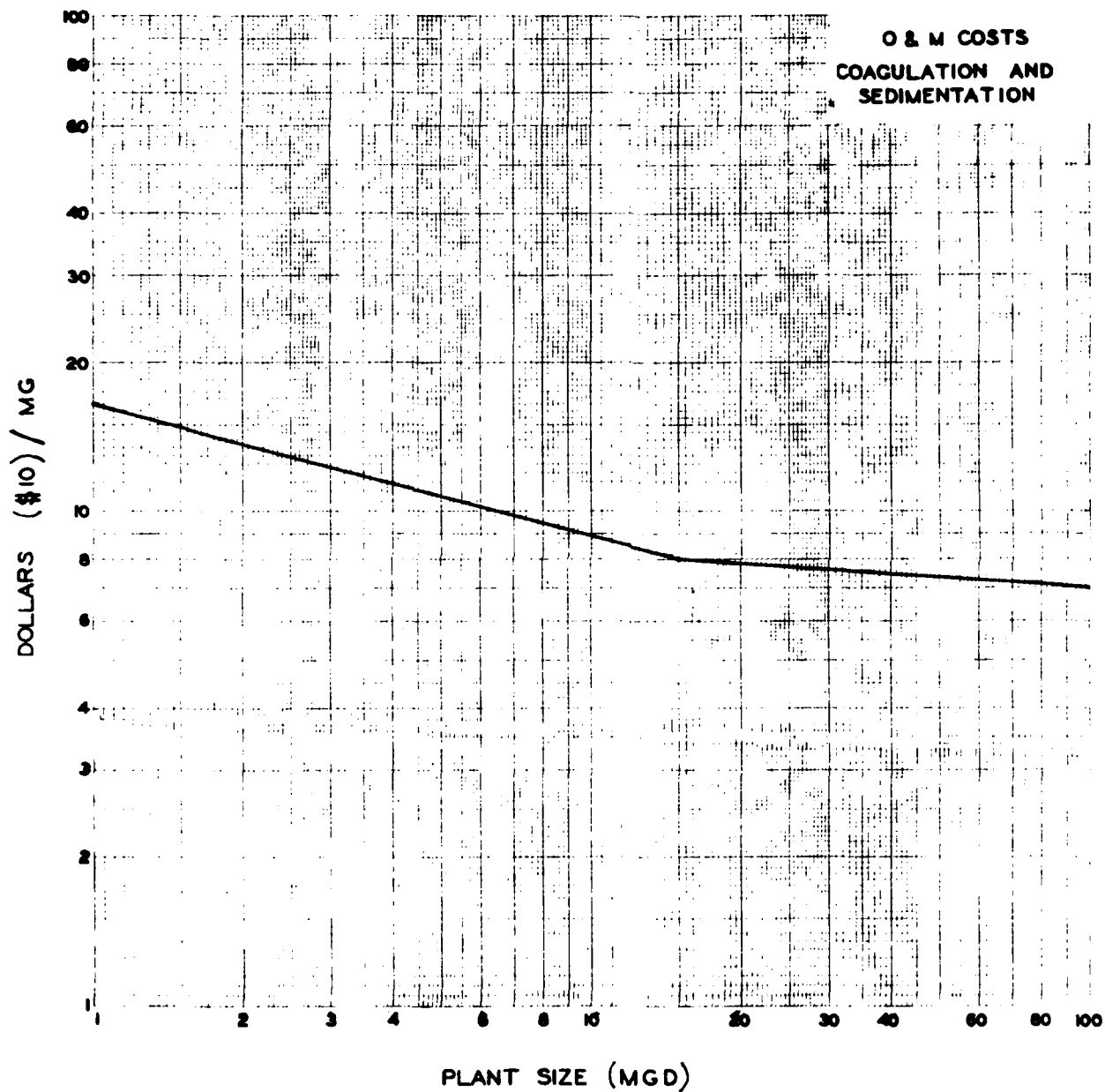


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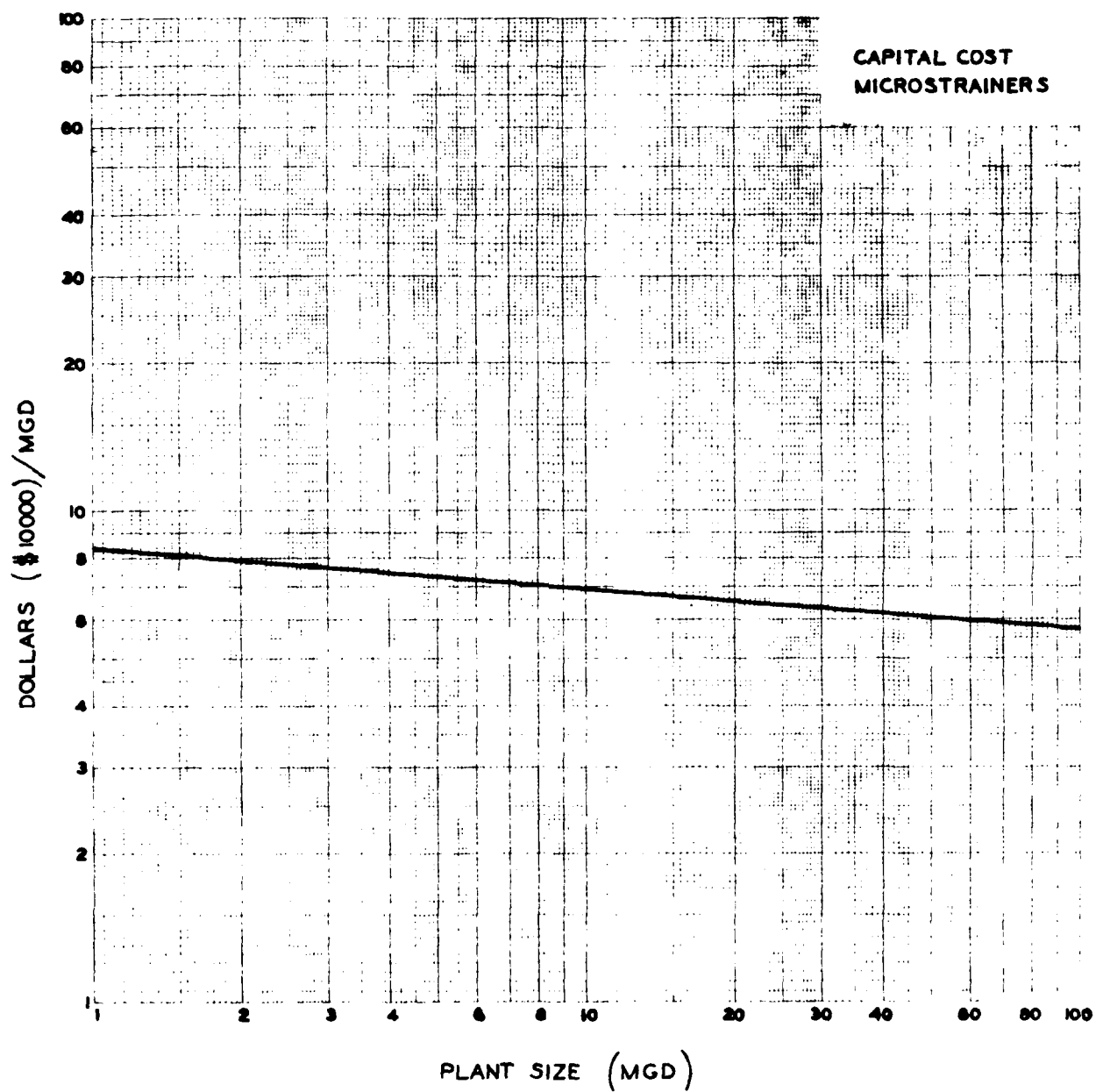


Figure No. 18

O & M COSTS  
MICROSTRAINERS

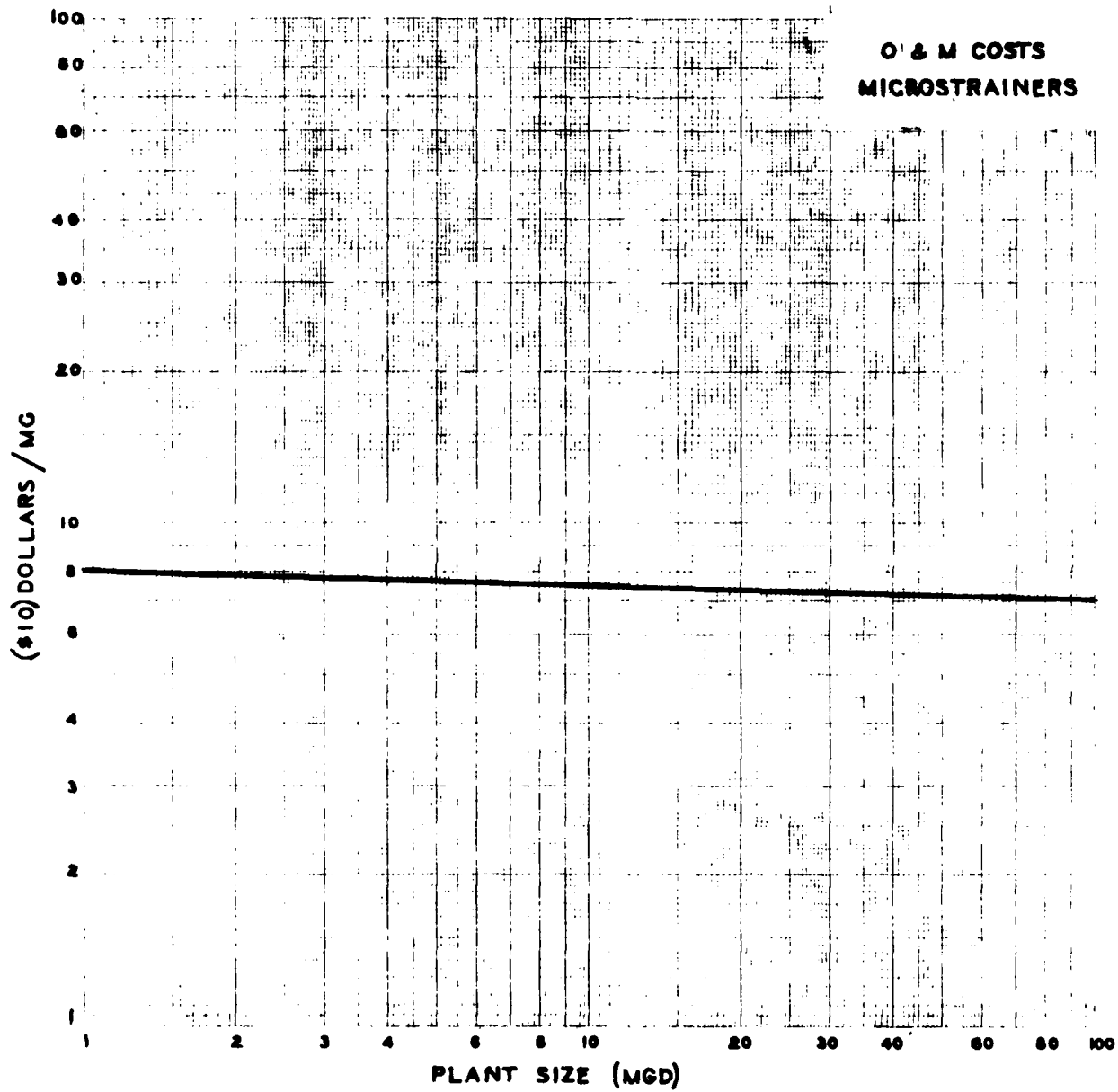


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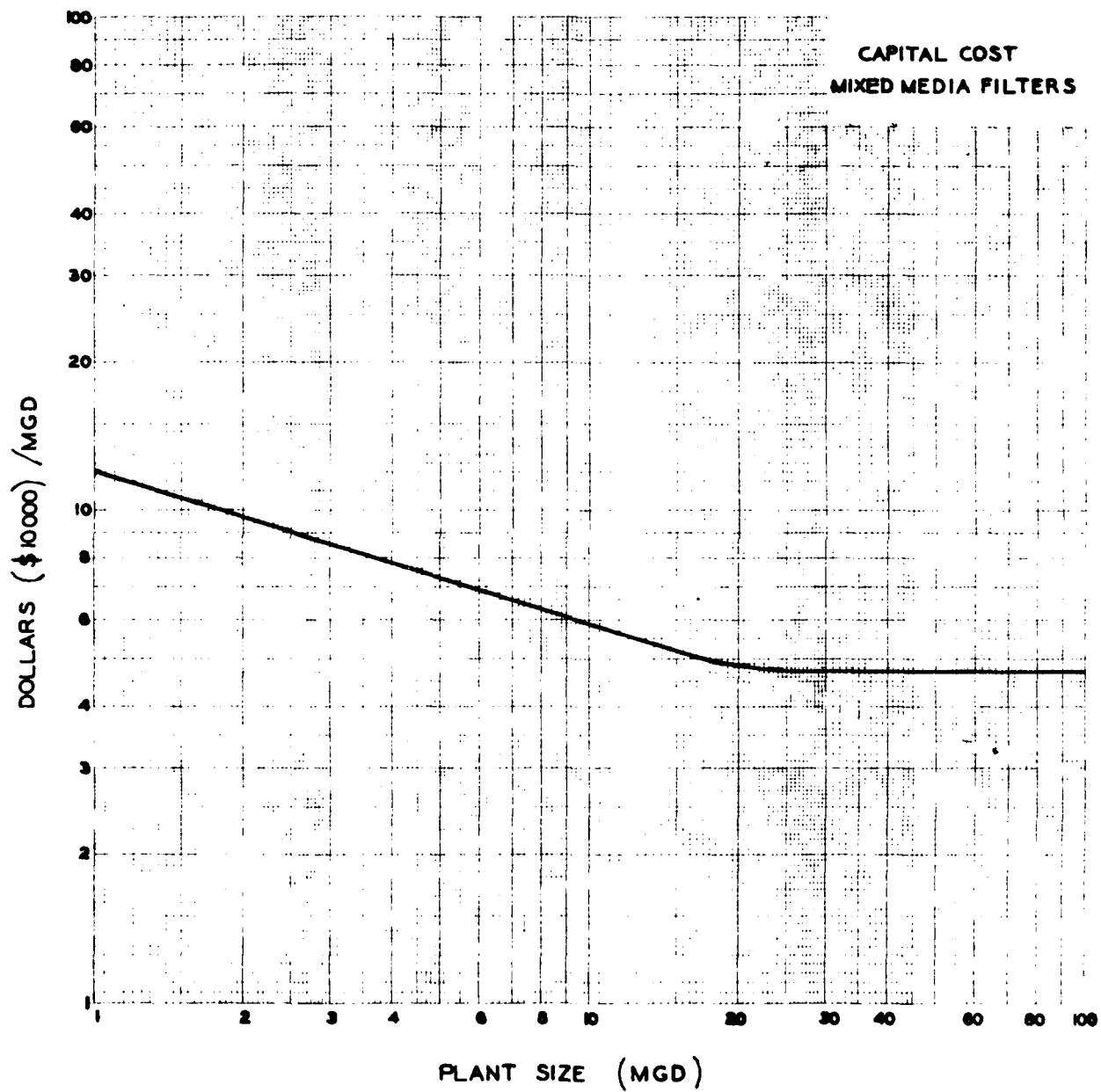


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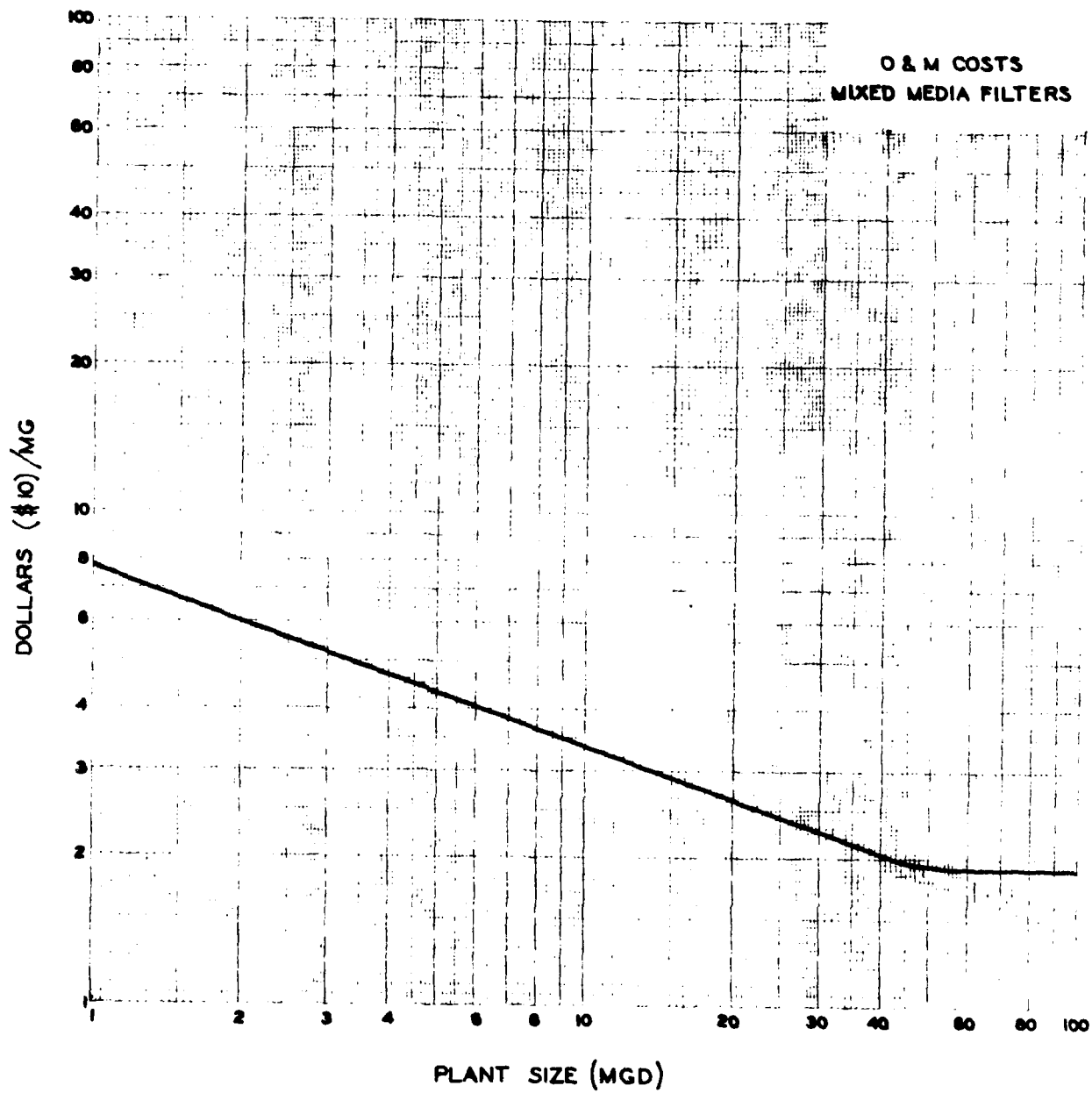


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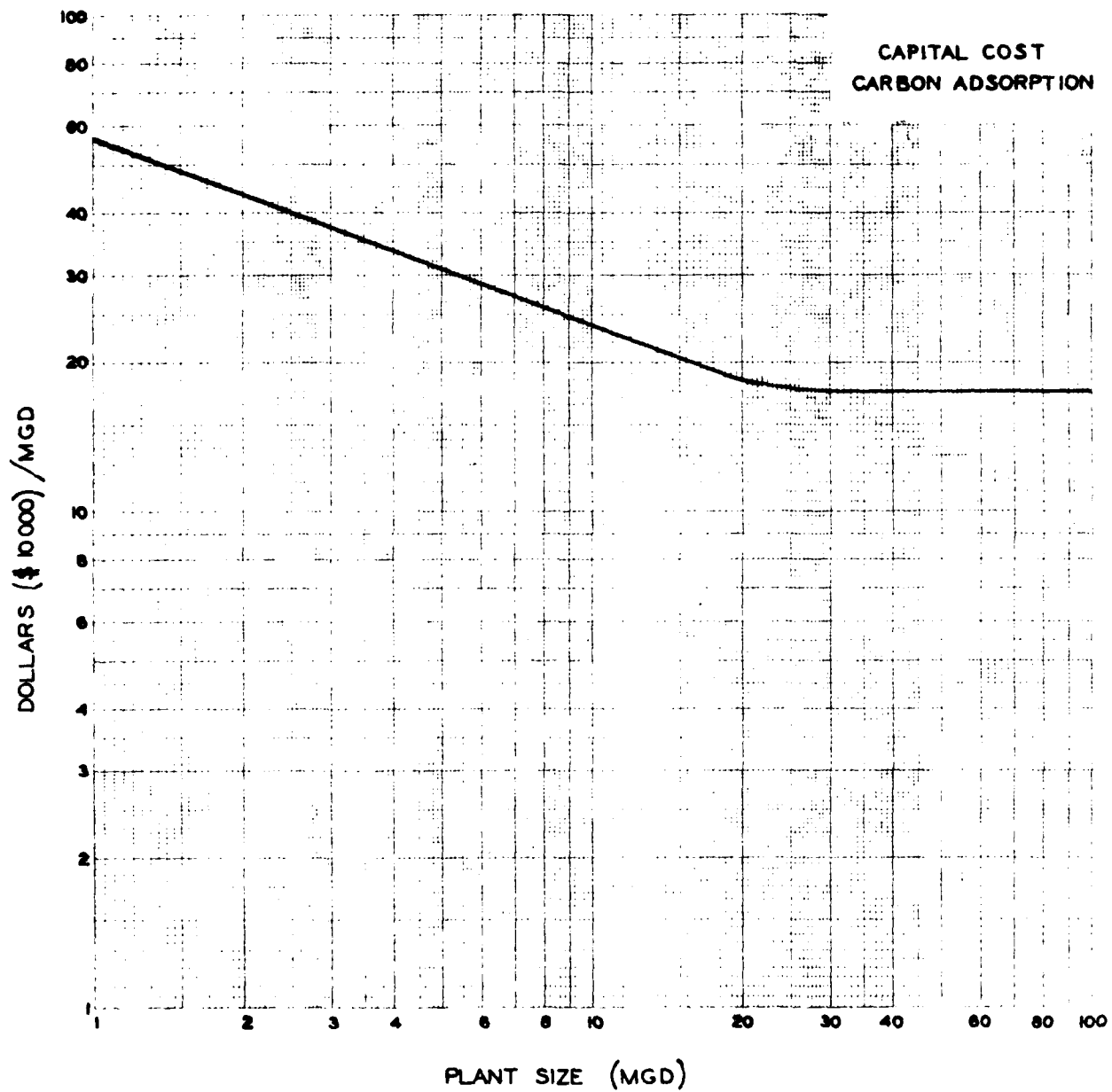


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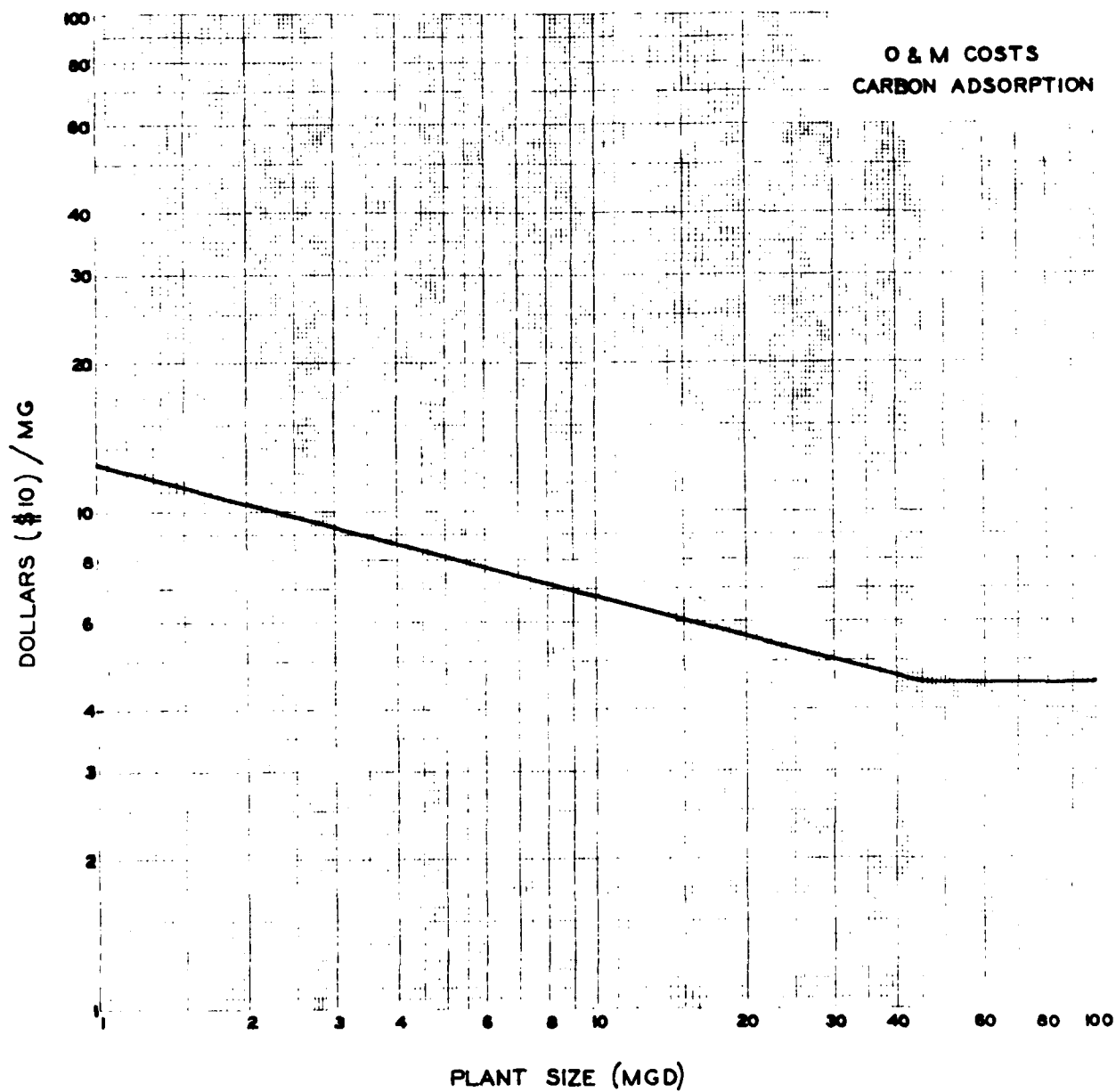


Figure No. 20A

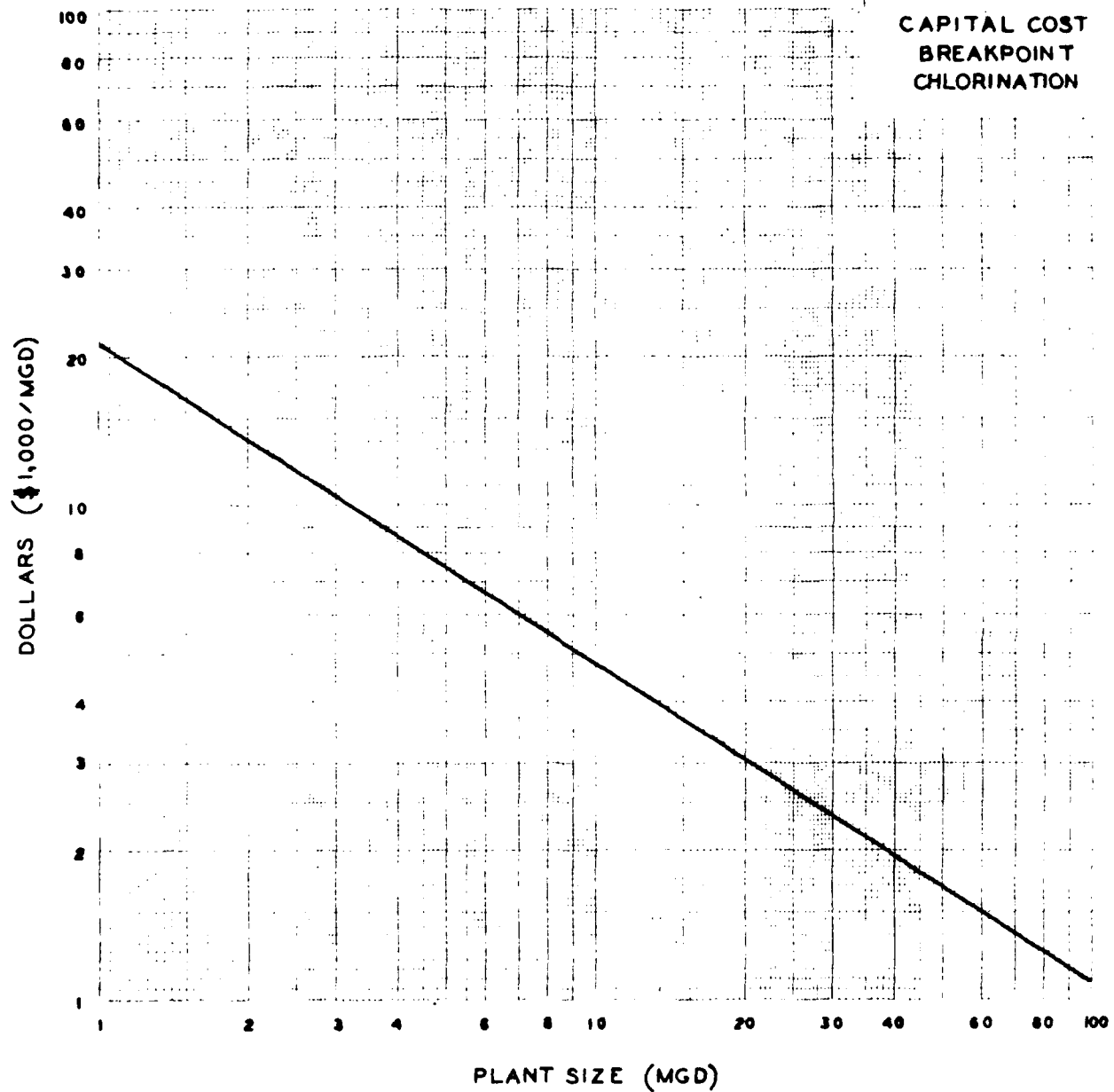


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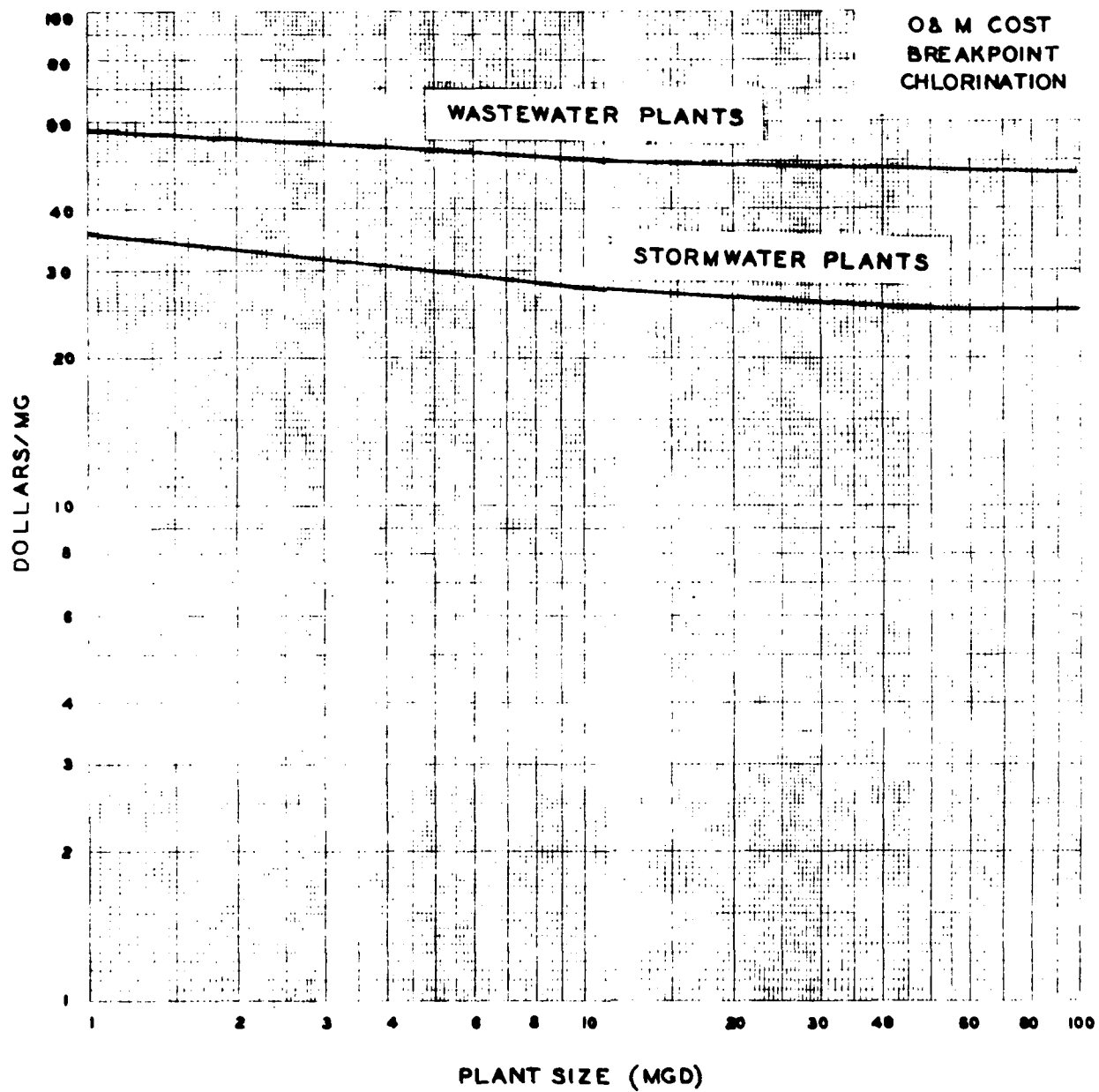


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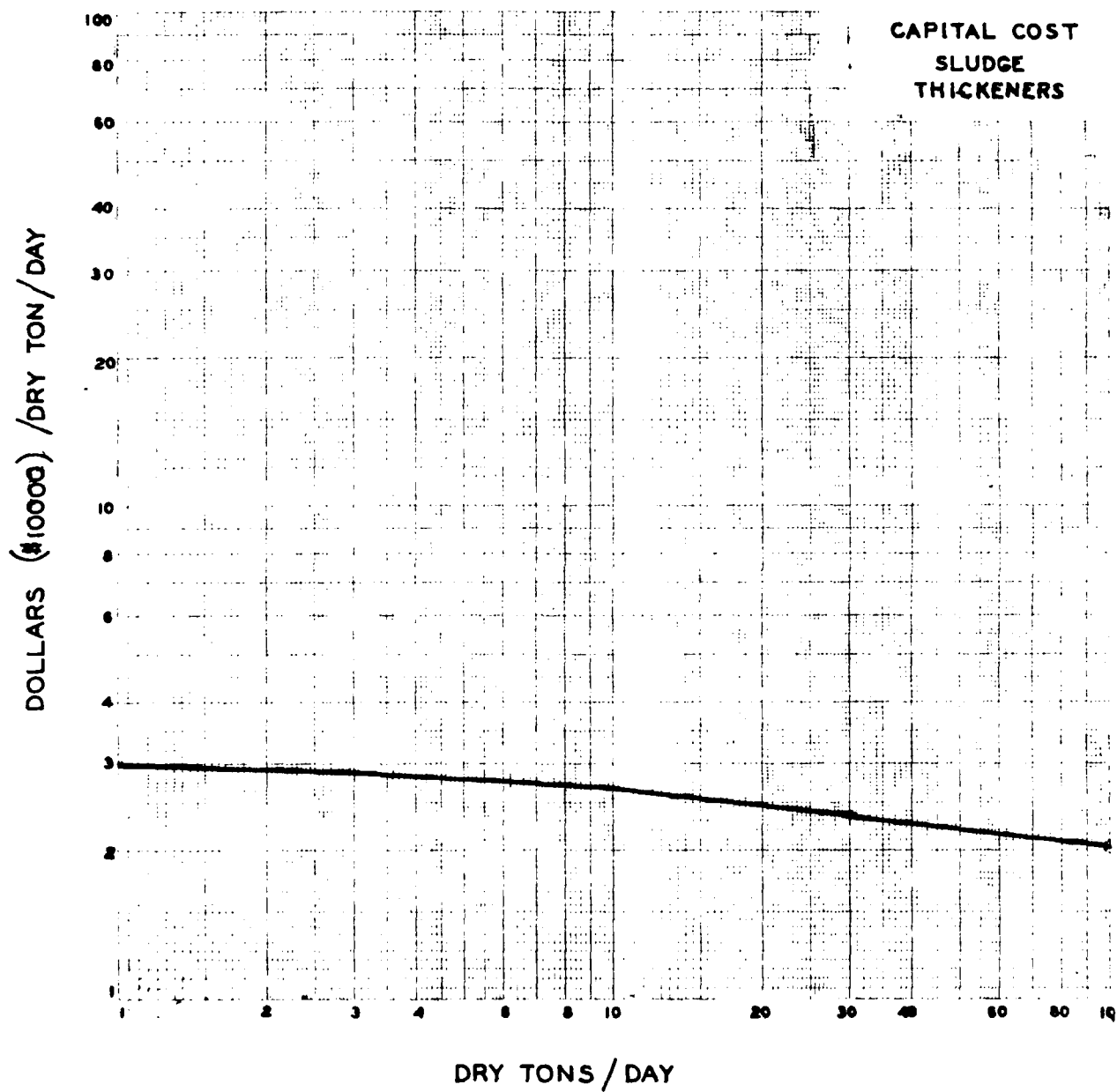


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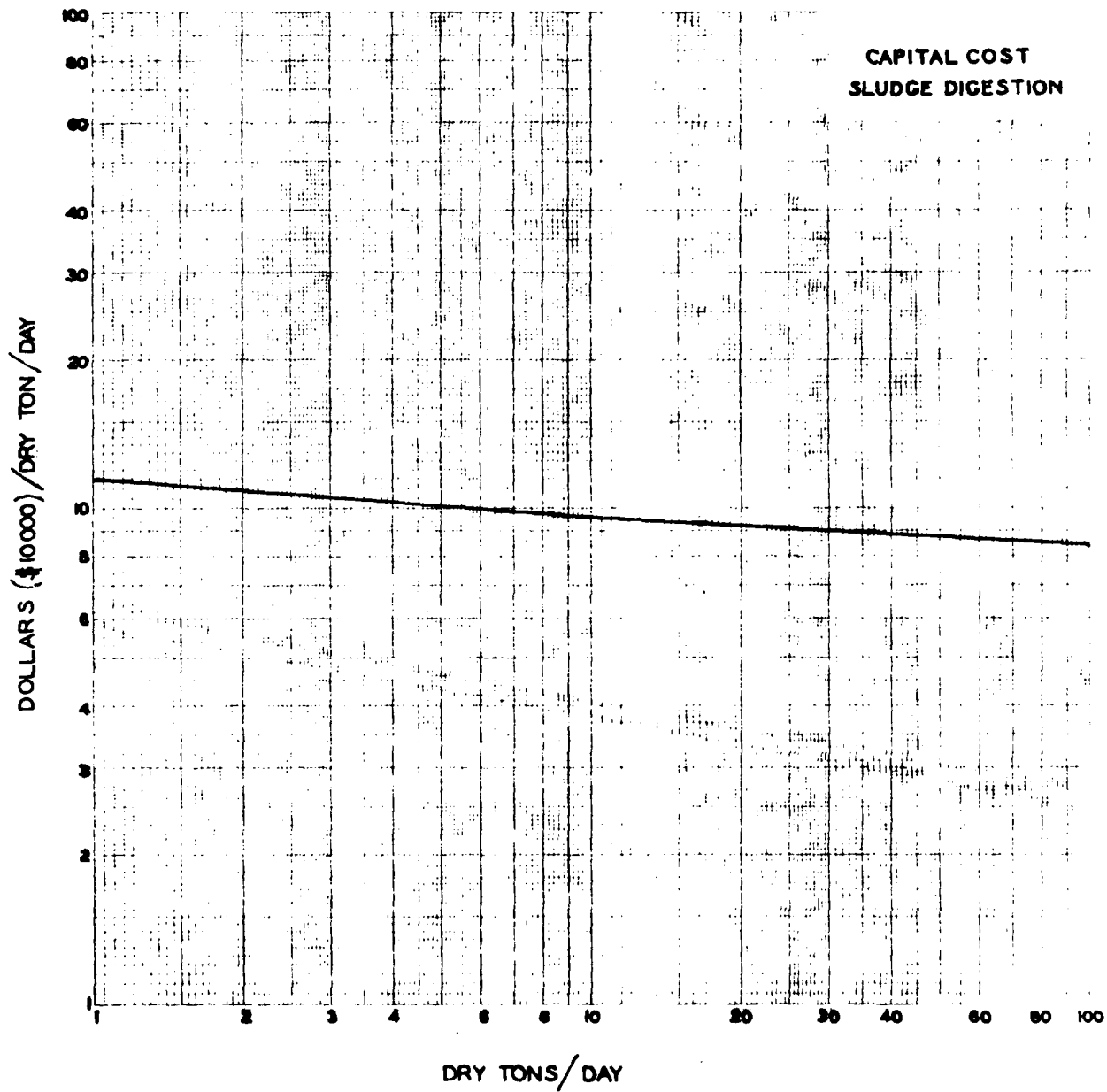


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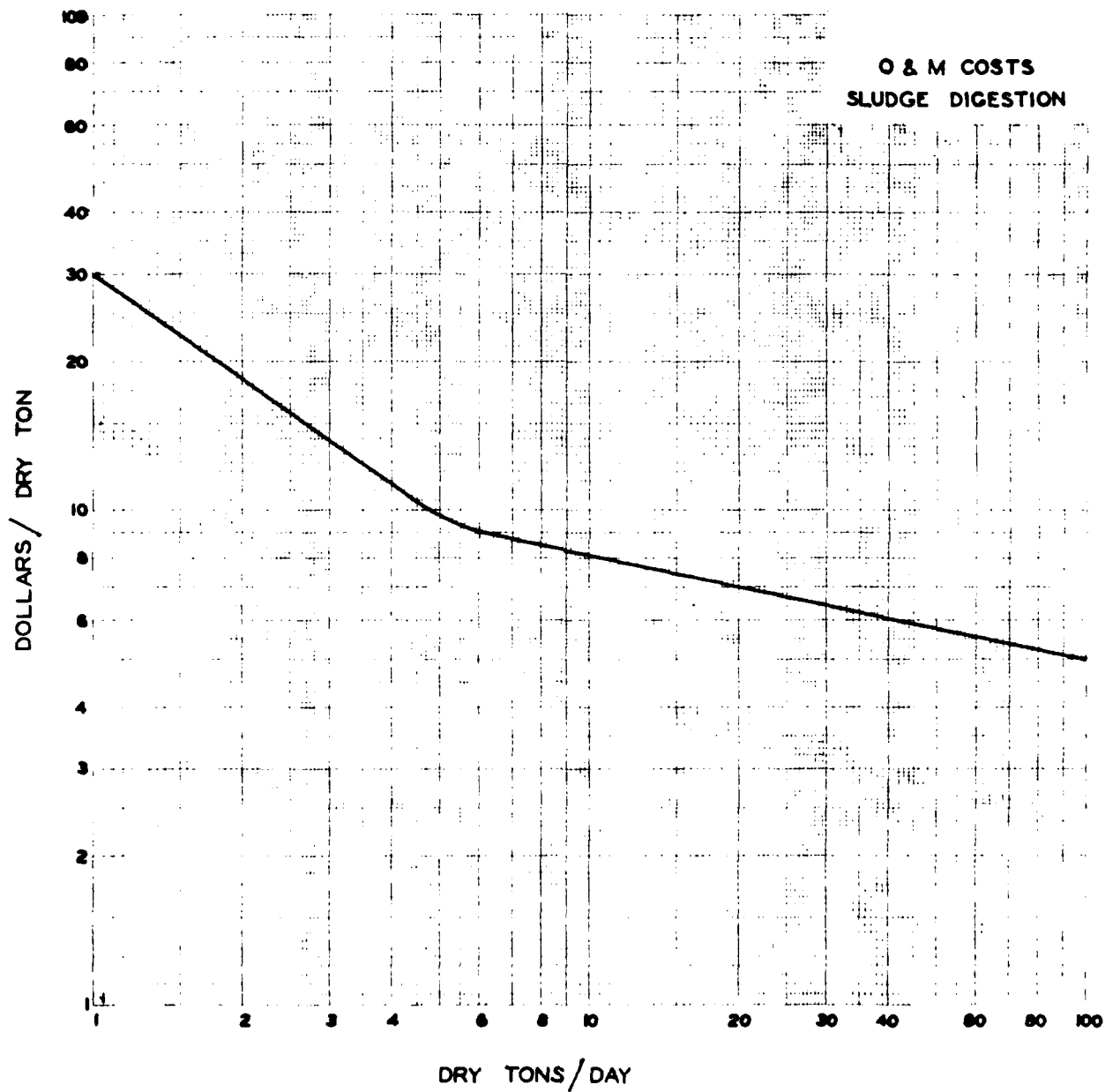


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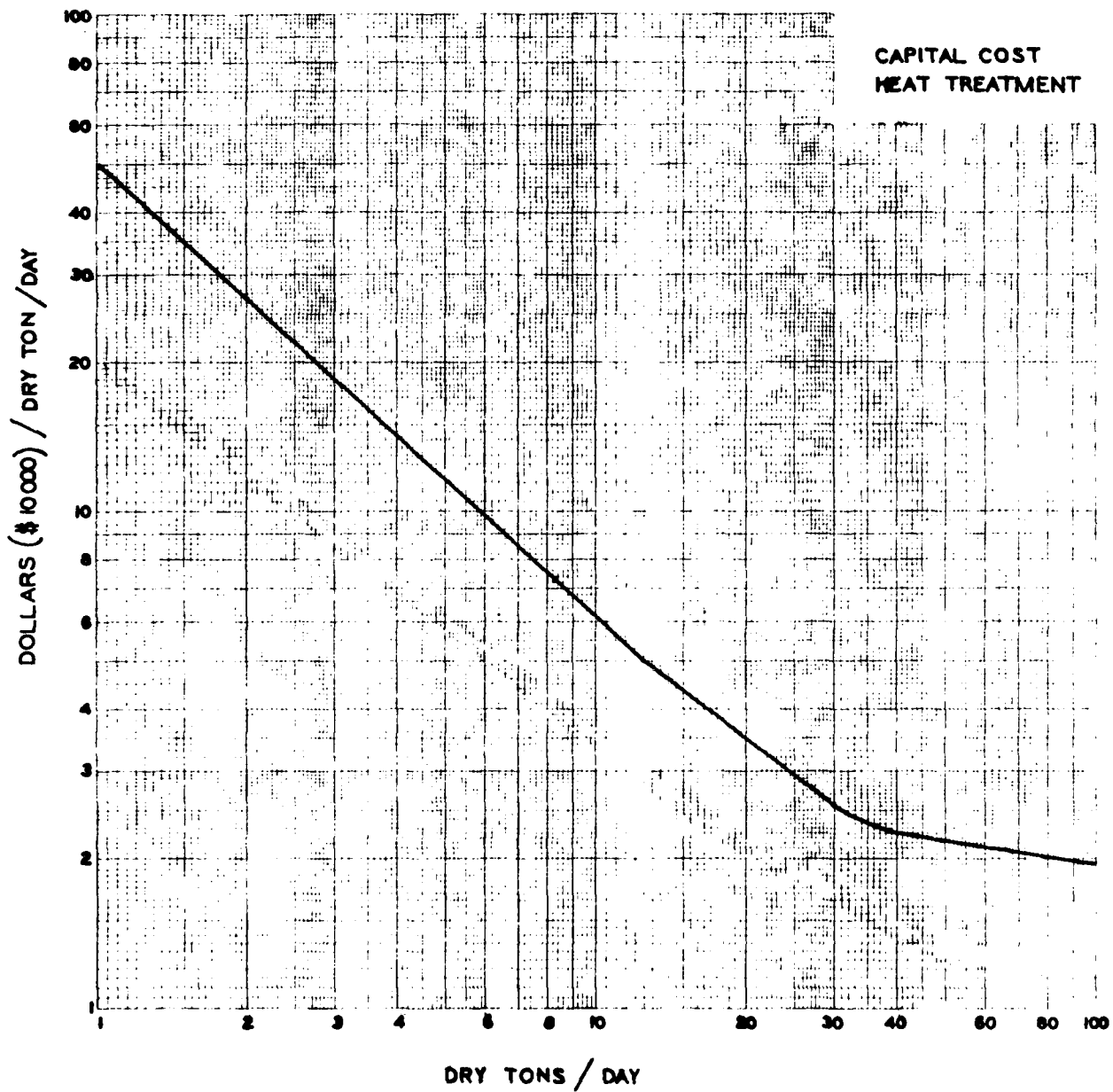


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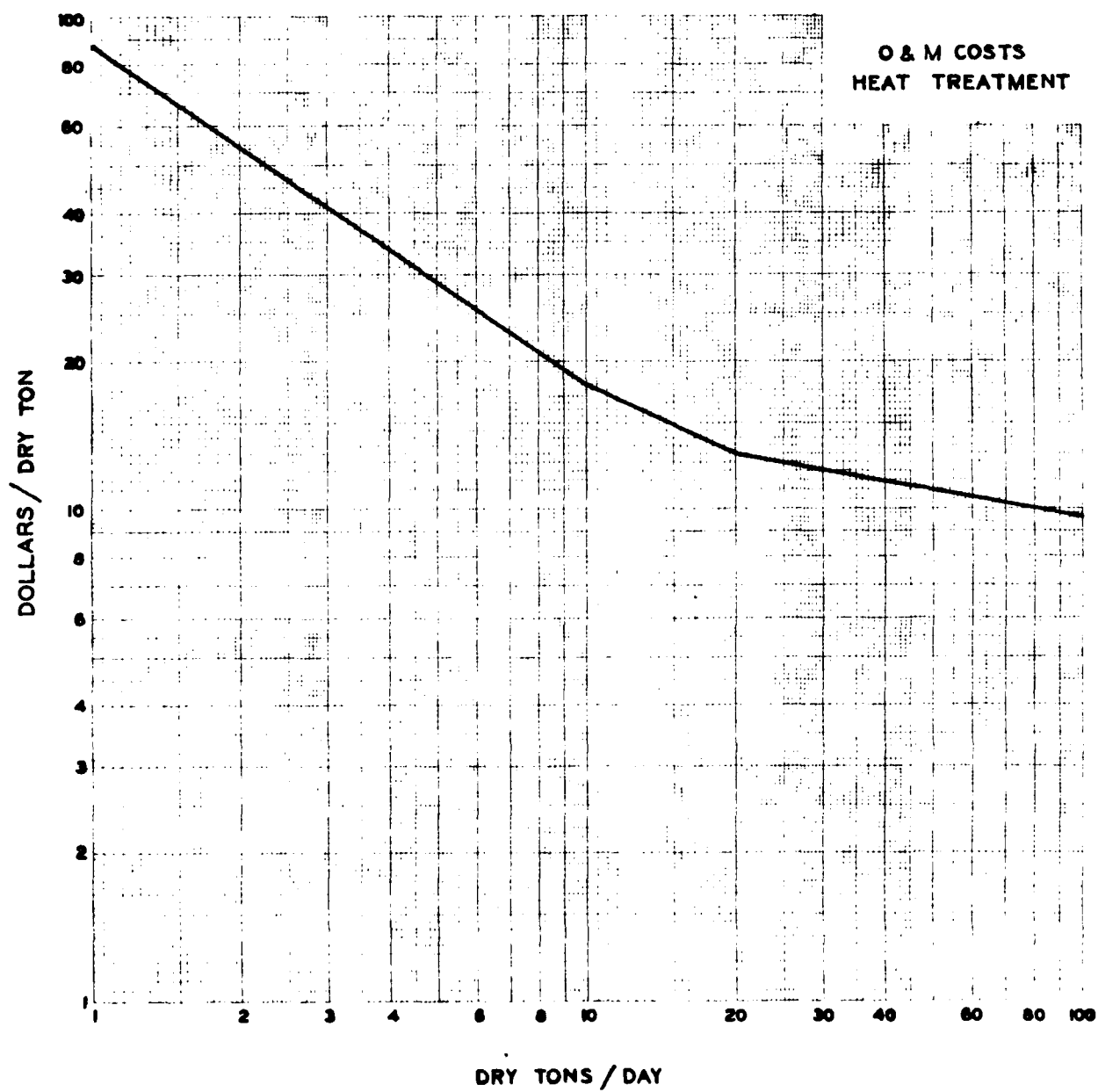


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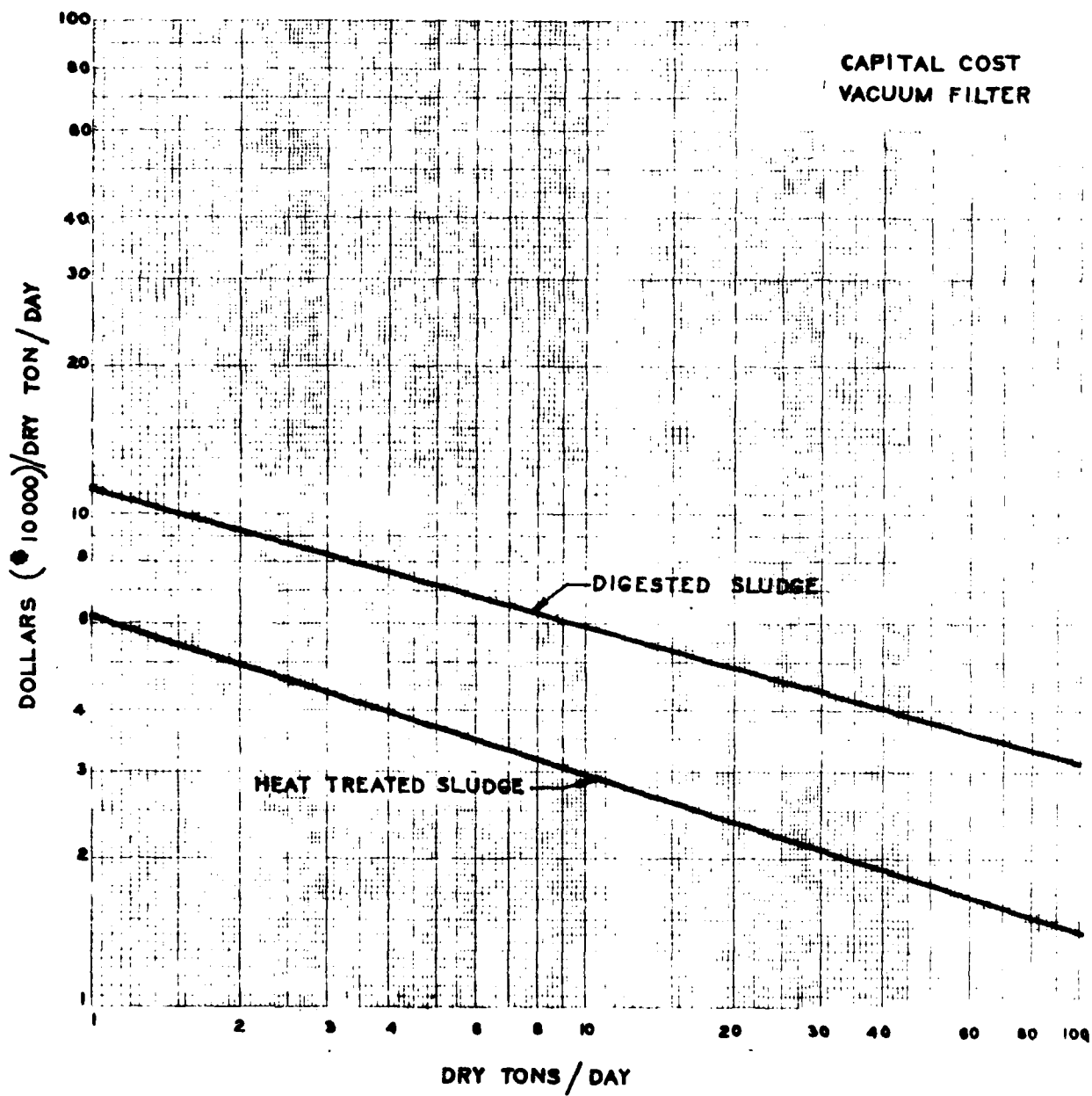


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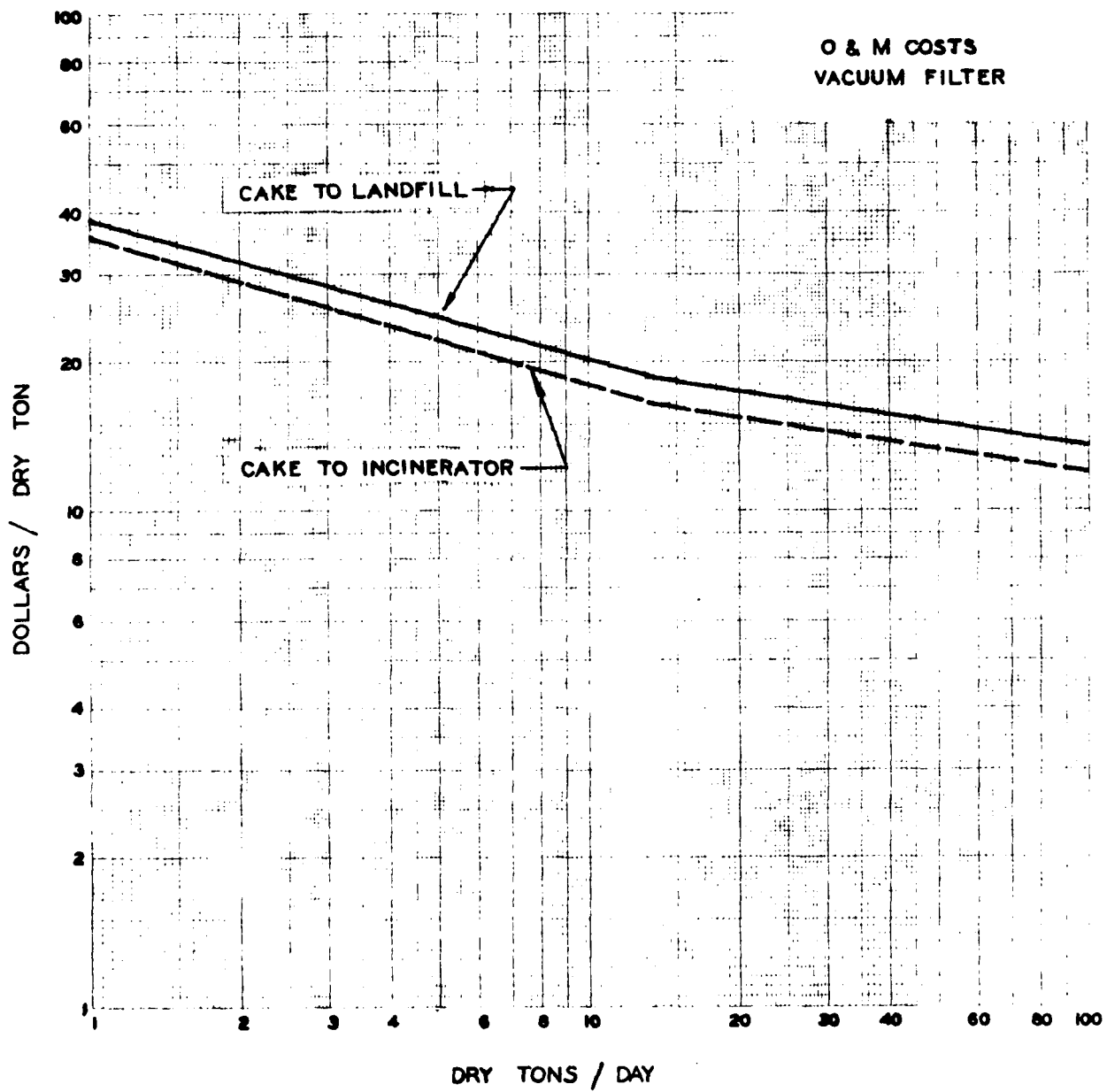


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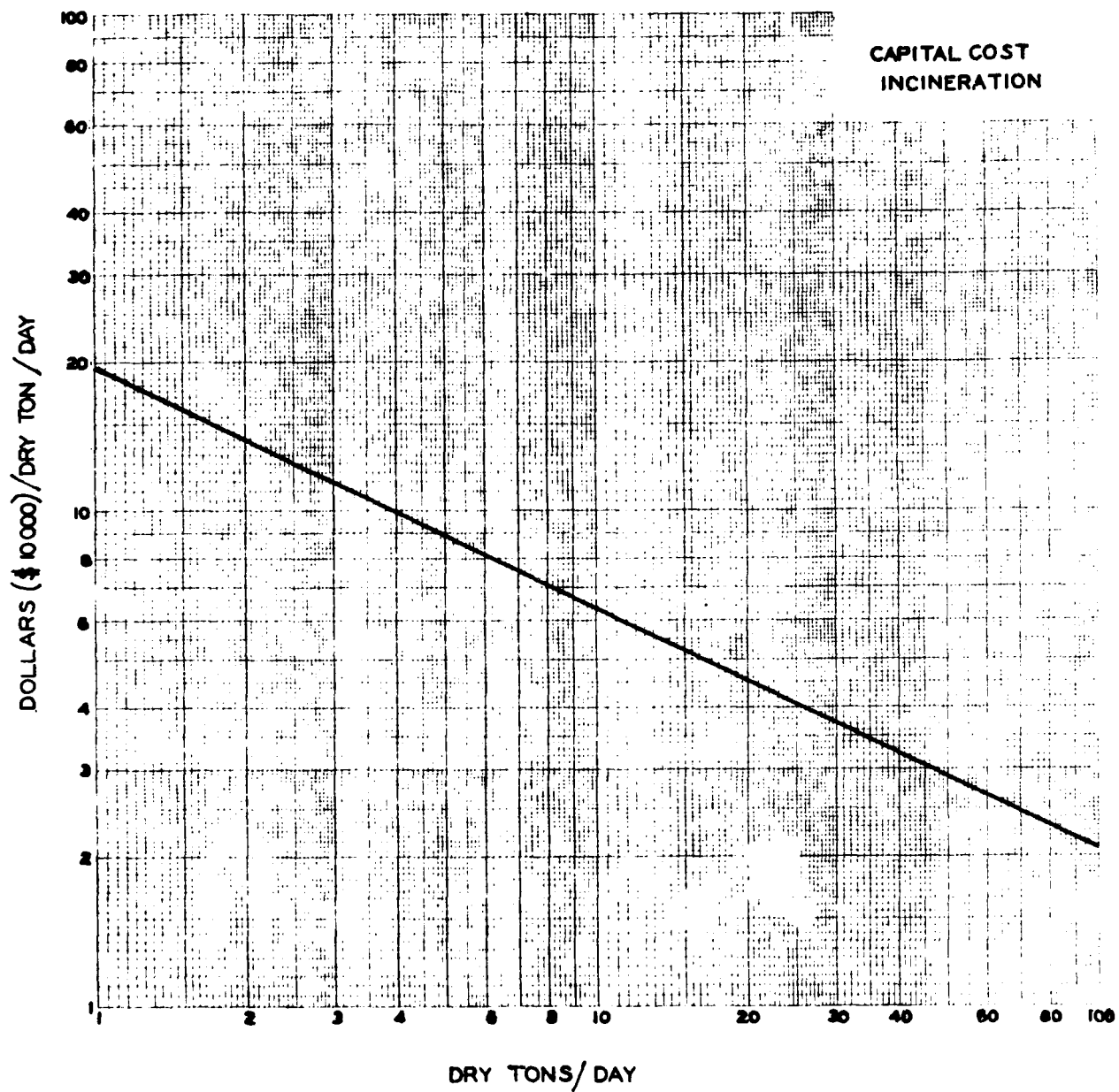


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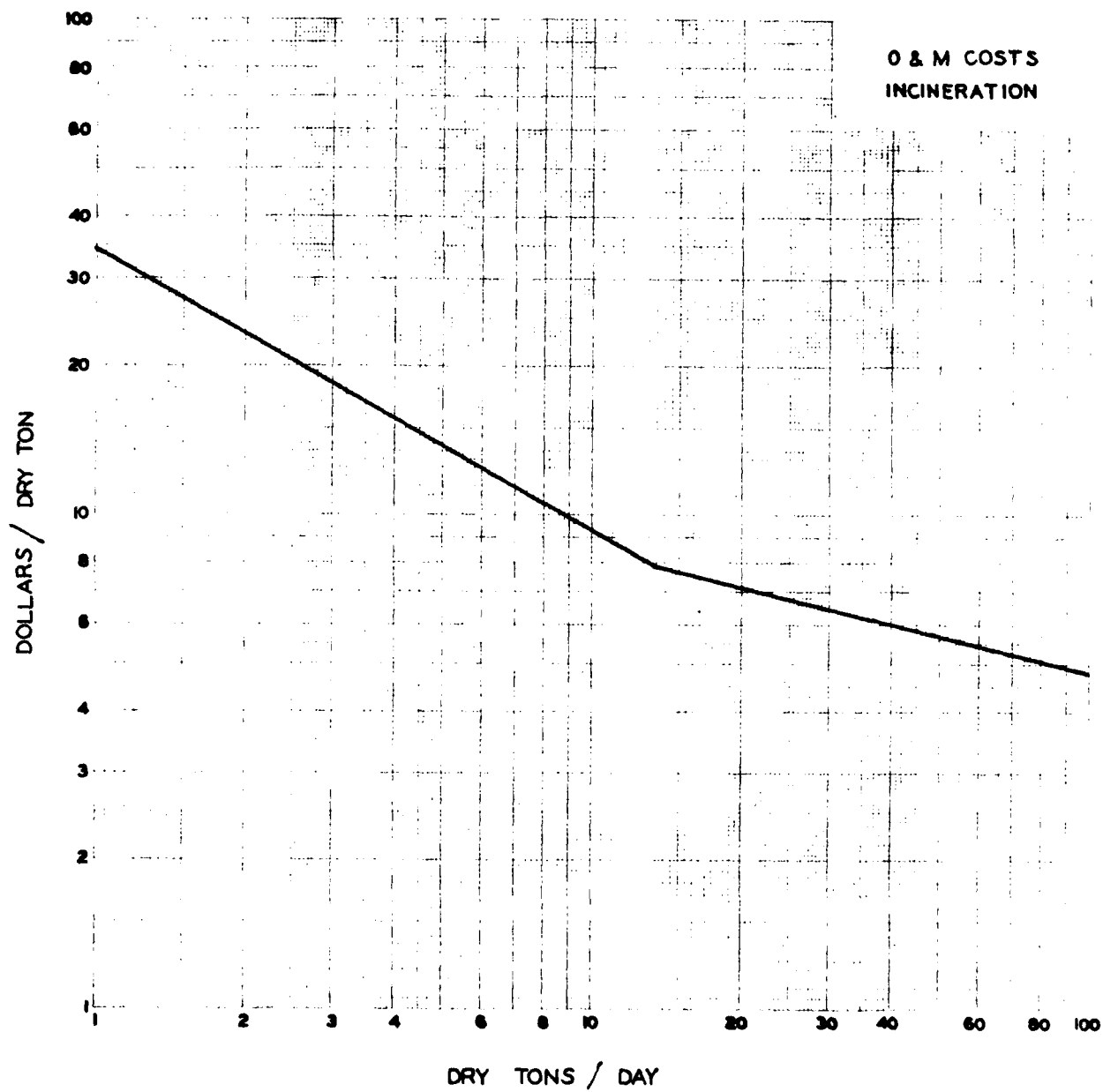


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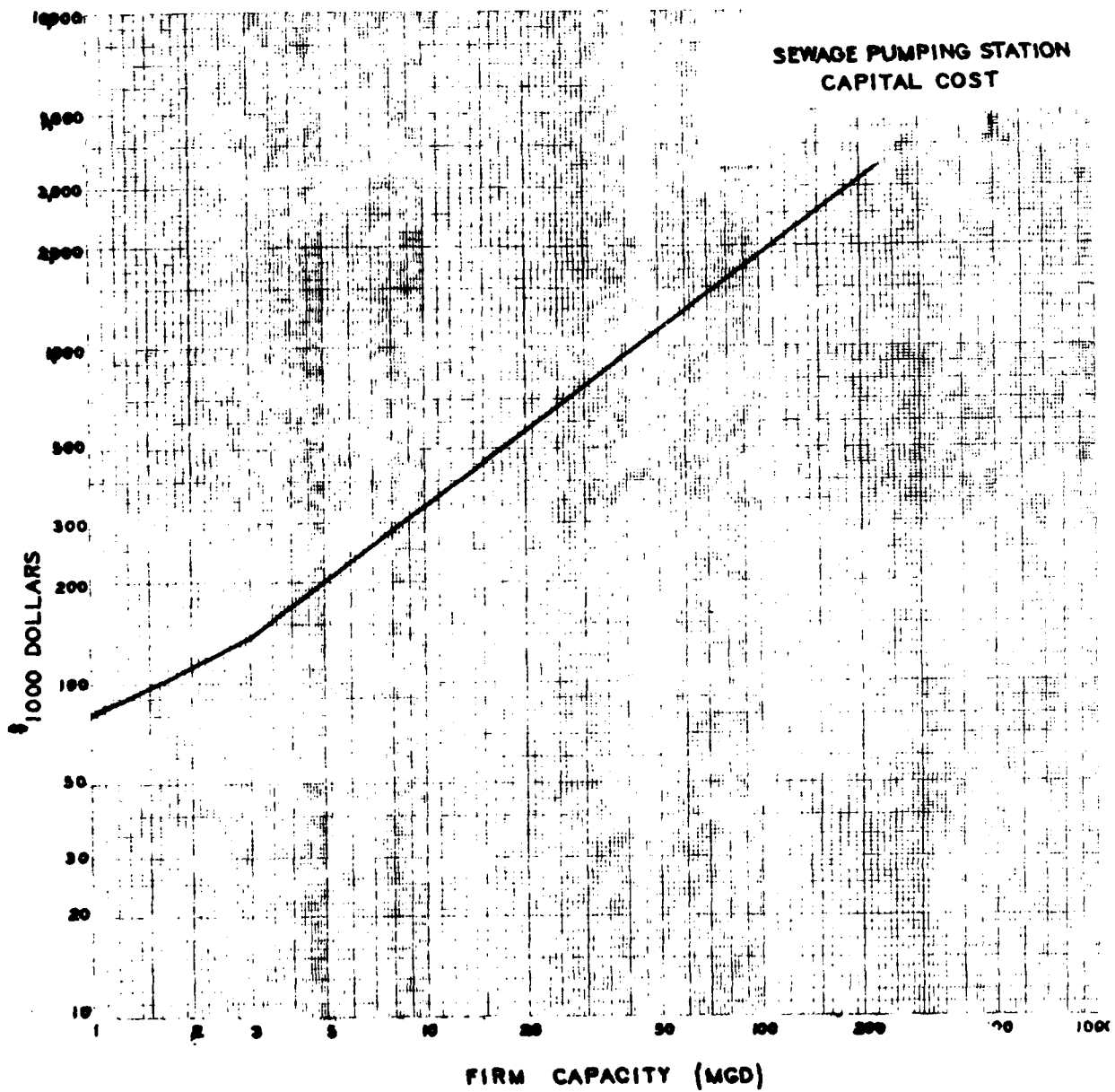


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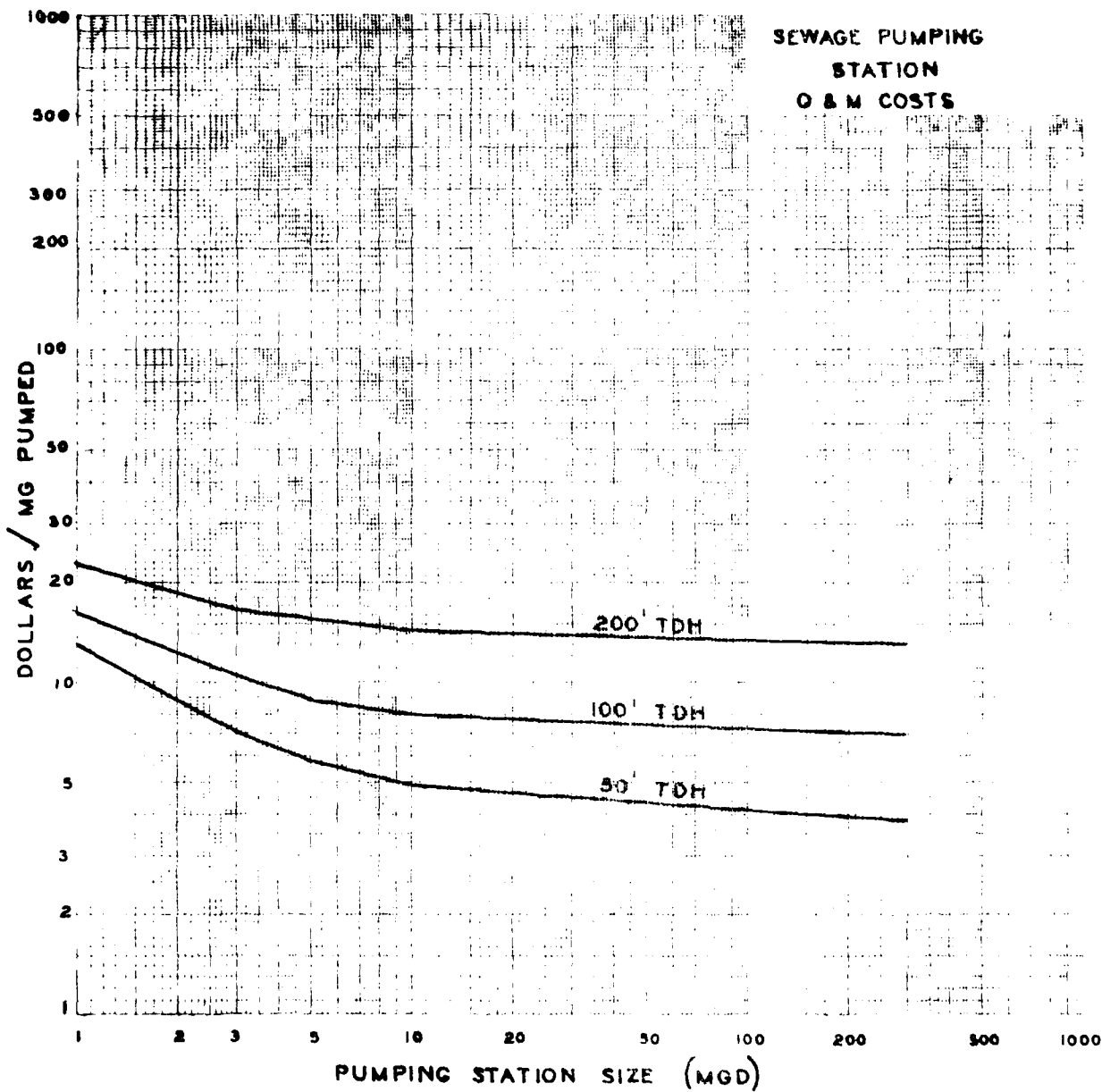


Figure No. 27A

GRAVITY SEWER COSTS  
PAVED URBAN AREA

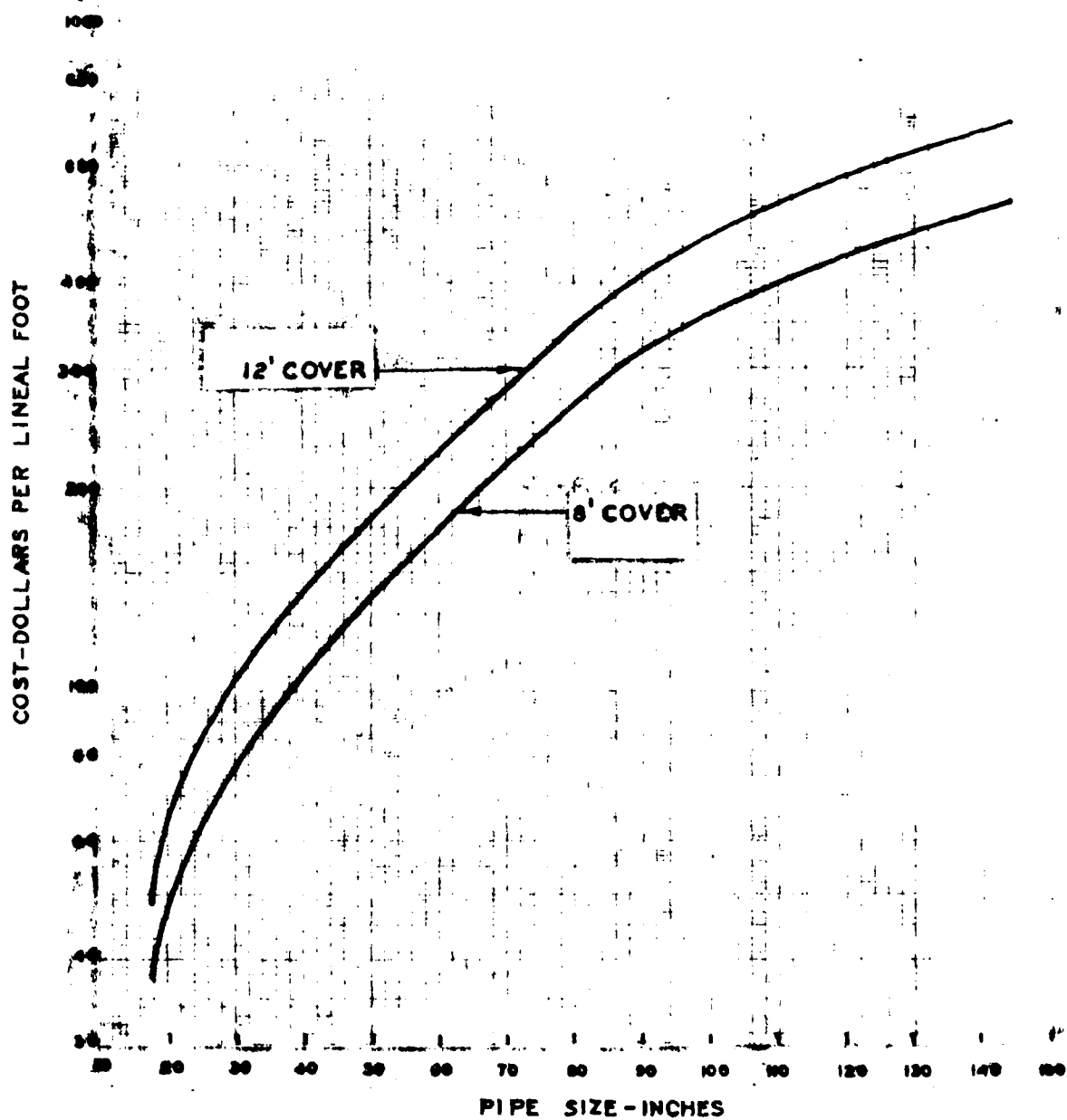


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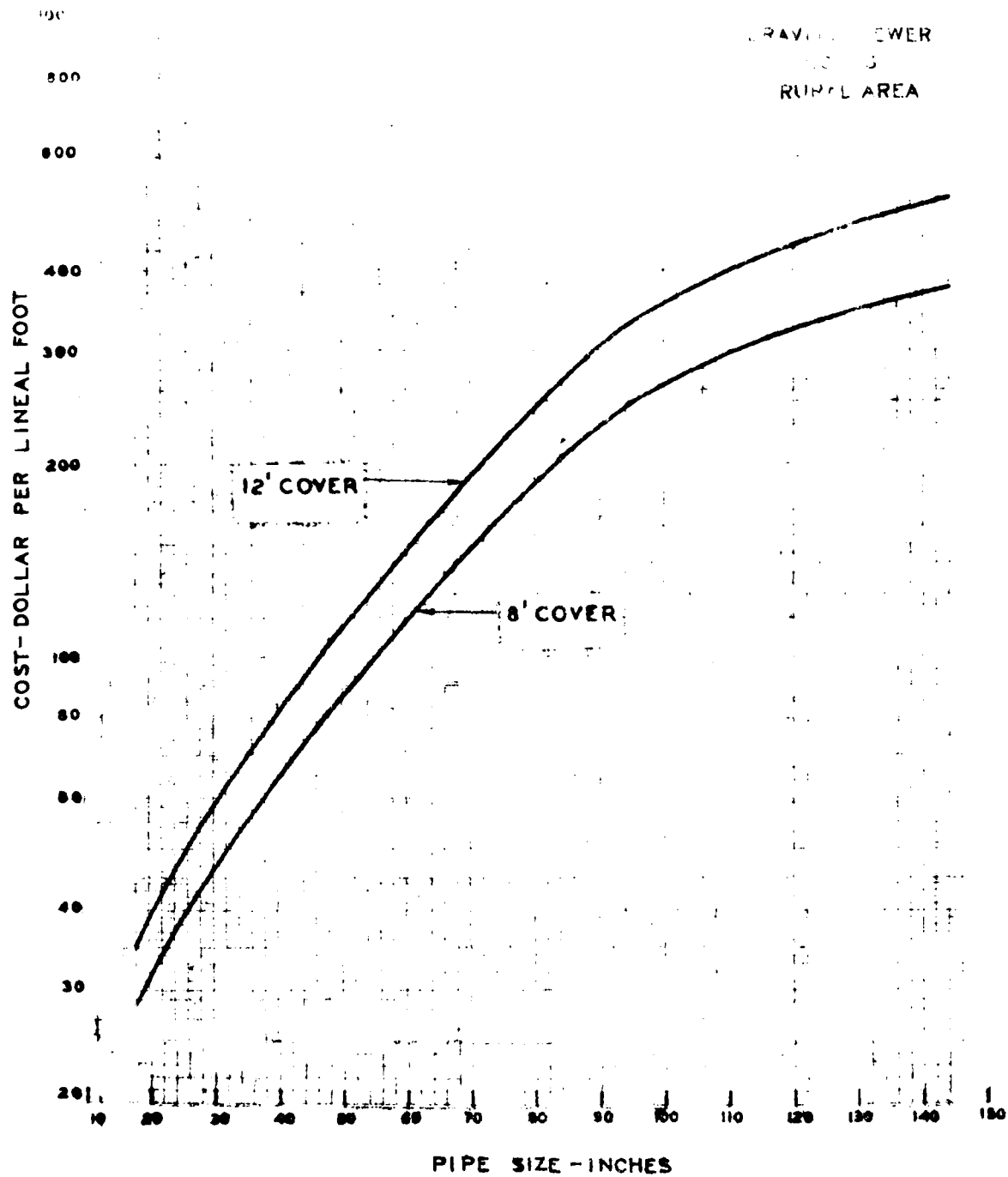


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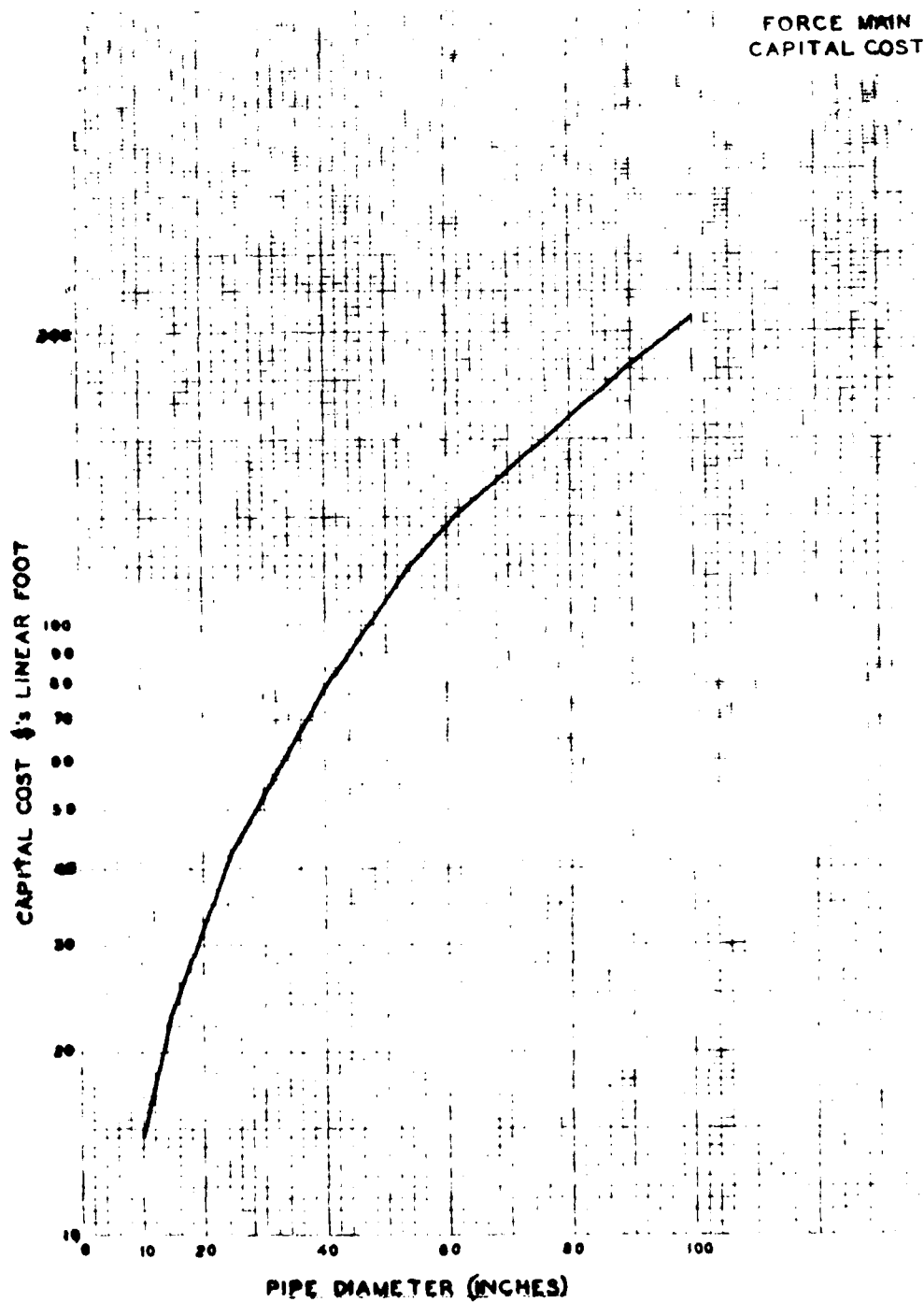


Figure No. 38  
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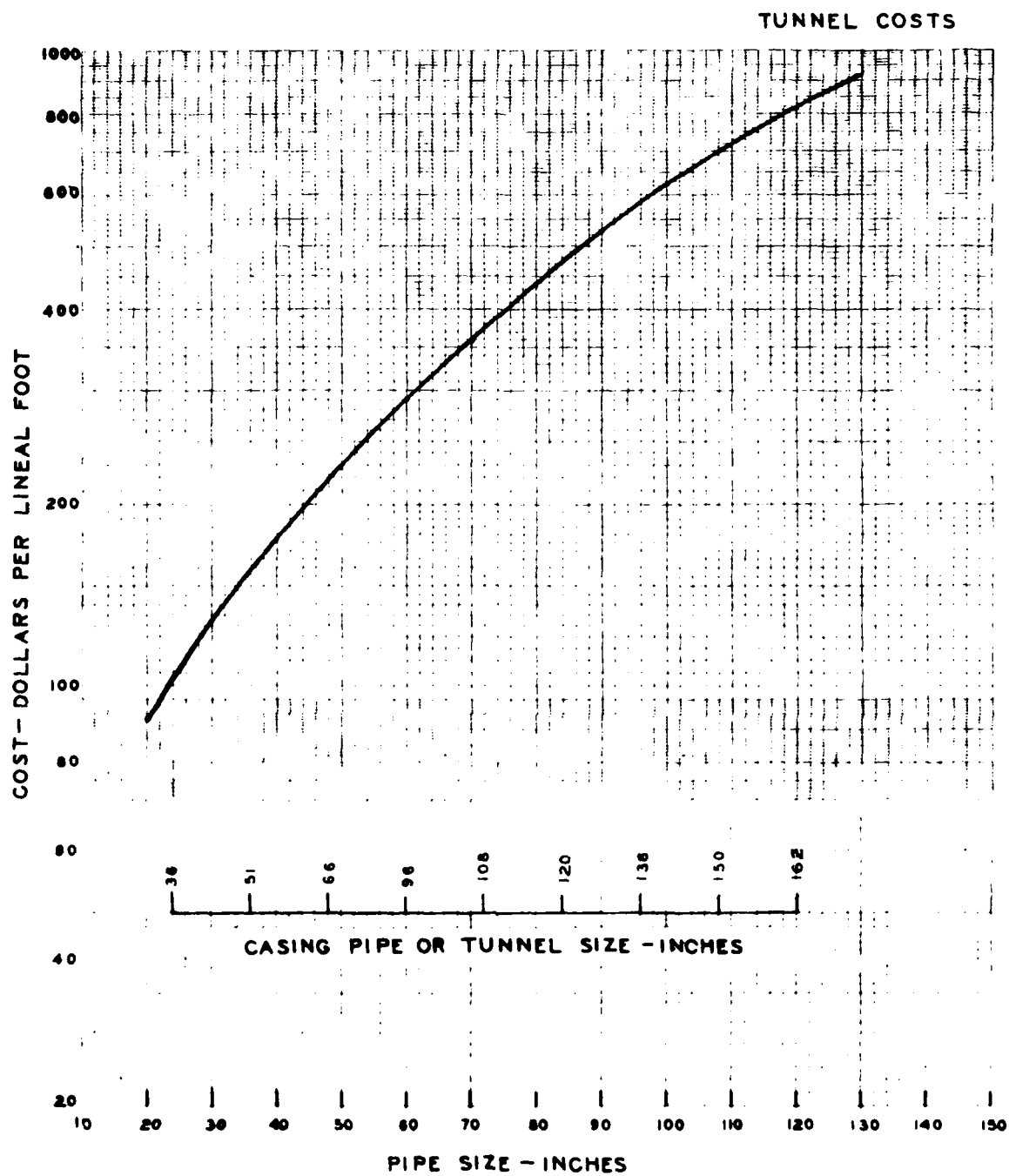


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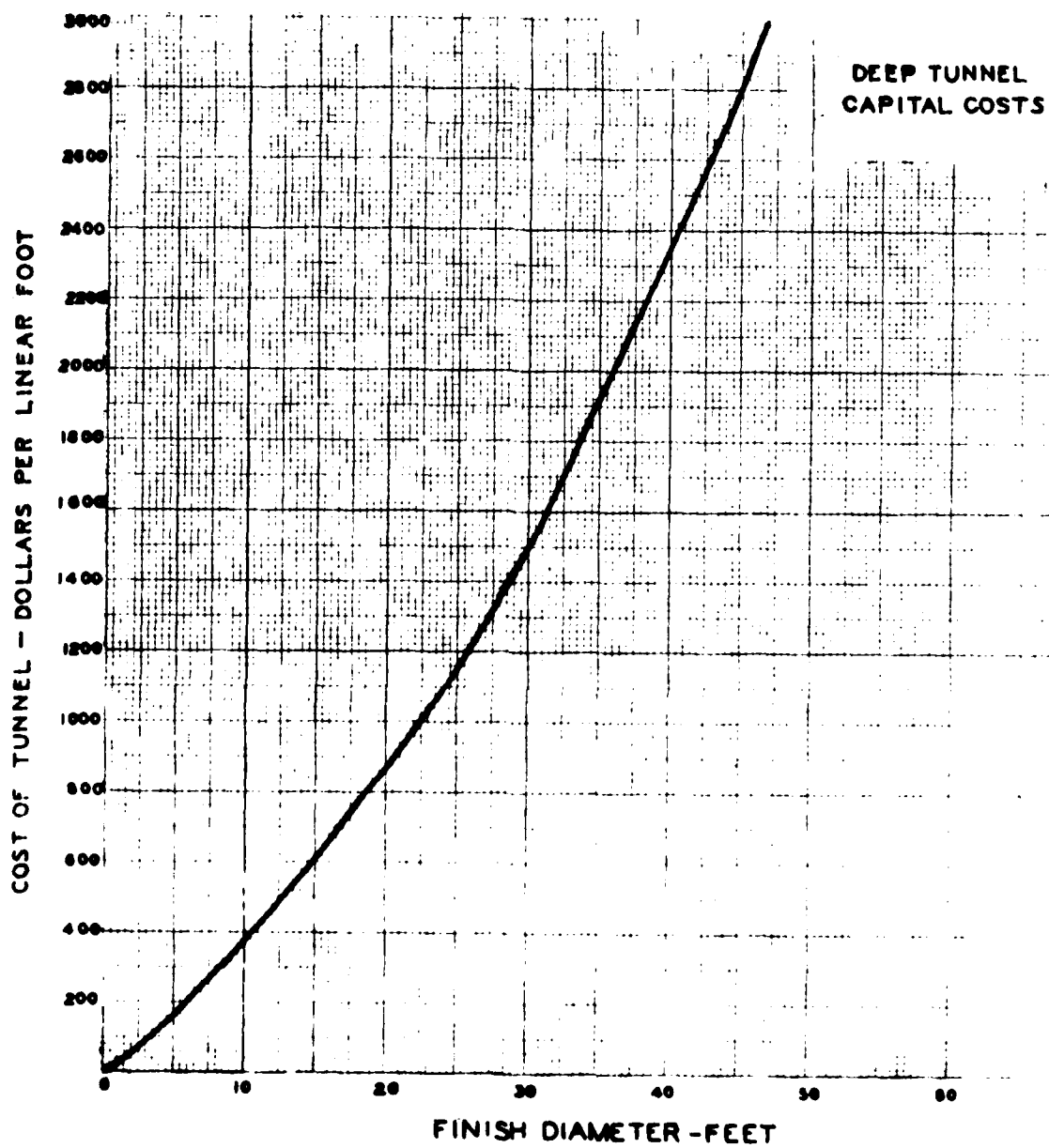


Figure No. 32

A

#### 4. MUNICIPAL TREATMENT PLANT DESIGN

##### 4.1 WASTEWATER TREATMENT SCHEMES

The municipal treatment plant design varied from plan to plan depending upon the level of treatment required or the designated treatment prior to land treatment. Following is a description of the five wastewater treatment plant variations. Cost curves were developed by adding appropriate unit process costs from Figures 11-32.

- 1) Preliminary Treatment Plant - Figures 33 and 33A represent the capital and operation and maintenance cost for preliminary treatment. This cost includes facilities for screening, aerated grit chambers, and flow measurement. This cost was used in those plans where aerated lagoons were the method of secondary treatment prior to land application.
- 2) Conventional Activated Sludge Plant - Figures 34 and 34A represent the capital cost and the operation and maintenance cost for a conventional activated sludge plant including disinfection by chlorination. This curve does not reflect any costs for sludge handling. These costs were used in those plans where secondary treatment was required prior to land application.
- 3) Advanced Biological Treatment Plant (Level 1) - Figures 35 and 35A represent the capital and operation and maintenance cost for an advanced biological treatment plant to achieve Level 1 criteria. The schematic diagram of this plant is shown in Figure 5. The costs include those for a conventional activated sludge plant, nitrification, mixed media filtration, phosphorus removal, and chlorination. These curves do not reflect any cost for sludge handling. This plant was used in all Level 1 plans where a water

based plant was required.

- 4) Advanced Biological Treatment Plant (Level 2) - Figures 36 and 36A represent the capital cost and operation and maintenance cost for an advanced biological treatment plant to achieve Level 2 criteria. The schematic diagram of this plant is shown in Figure 7. The costs include those for a conventional activated sludge plant, nitrification, denitrification, mixed media filtration, phosphorus removal, carbon adsorption, and chlorination. These curves do not reflect any costs for sludge handling. This plant was used on all Level 2 plans where a water based plant was required except for Plan 11.
- 5) Physical-Chemical Treatment Plant (Level 2) - Figures 37 and 37A represent the capital and operation and maintenance cost for a physical-chemical treatment plant to achieve Level 2 criteria. The schematic diagram of this plant is shown in Figure 8. These costs include those for coagulation and sedimentation (two stage lime clarification), mixed media filters, carbon adsorption, breakpoint chlorination, downflow carbon, and ozonation. The curve includes cost for sludge dewatering and recalcination. Costs do not include handling of the waste ash. This plant was used for all water-based plants in Plan 11.

#### 4.2 SLUDGE HANDLING SCHEMES

Each of the wastewater treatment schemes described above generate different quantities of sludge. By referring to the mass diagrams of the treatment schemes, the sludge quantities generated were determined in TPD/MGD (Dry Tons per Day per million gallons per day). The following

lists the quantities of sludge generated for each scheme:

Conventional Activated Sludge: 0.645 TPD/MGD

Advanced Biological Treatment Plant (Level 1): 1.06 TPD/MGD

Advanced Biological Treatment Plant (Level 2): 1.14 TPD/MGD

Physical-Chemical Treatment Plant (Level 2): 0.86 TPD/MGD\*

\*TPD of waste ash from recalcination furnace.

The sludge handling technique varied from plan to plan as described in the Formulation Phase 1, Synopsis Report, prepared by the Plan Formulators. Following is a brief description of the four sludge disposal variations used in the development of the alternative plans cost estimation. The quantity of sludge generated as previously described was the basis of design of the sludge handling facilities.

- 1) Strip Mine Application in Harrison County - The sludges generated in the biological plants were assumed to be digested and pumped to the main transmission lines. The land contractor included the cost of the main transmission lines in his section. Figures 38 and 38A represent the capital cost and operation and maintenance cost for sludge digestion. A 5 percent solids concentration of discharged sludge was assumed. Pumping costs and transmission costs to the main transmission line was based on the data presented in the Unit Cost section. Digestion removal efficiencies were assumed for the different treatment plant schemes based on the mass diagrams. For the conventional activated sludge plant, the dry tons per day discharged from the digester was 53% of the TPD of sludge generated by the plant. For the advanced biological treatment plant, Level 1 and 2, the dry tons per day discharged was 64% of the TPD of sludge generated by the plant.
- 2) In-basin Agricultural Application - The sludges generated in the

biological treatment plants were digested and vacuum filtered. The land treatment contractor included the cost of picking up the filter cake and applying it to the land in his section. Figures 39 and 39A represent the capital cost and operation and maintenance cost for sludge digestion and vacuum filtration. A 20 percent solids concentration was assumed for the filter cake. Different removal efficiencies were assumed for the different treatment plant schemes based on the mass diagrams. For the conventional activated sludge plant the dry tons per day of solids discharged from the vacuum filter was 60% of the TPD generated by the plant. For the advanced biological treatment plant (Levels 1 and 2), the dry tons per day discharged from the vacuum filter was 64% of the TPD generated by the plant.

- 3) Incineration - This process includes thickening of the waste activated sludge, storage of the combined sludges, heat treatment, vacuum filtration, and incineration. Figures 40 and 40A represent the capital cost and operation and maintenance cost for this incineration scheme. Only sludge generated in the advanced biological treatment plant was incinerated. The resultant dry tons per day on ash was 35% of the dry tons per day of sludge generated by the plant.
- 4) Ash Disposal - This sludge handling technique disposes of the waste ash from the incinerators in a sanitary landfill. The cost used for this technique was \$6 per dry ton of ash. This cost was used for the disposal of the waste ash from the recalcination furnace and for the disposal of the ash from the incineration disposal scheme.

#### 4.3 Cost Comparison

Tables 4 and 5 present the component costs for the advanced

biological treatment plants and the physical-chemical treatment plants at Level 2. The tables show the costs used in the Chicago Regional study versus that used in the Cleveland Regional study.

TABLE 4  
ADVANCED BIOLOGICAL TREATMENT PLANT (LEVEL 2)

	<u>Chicago</u>		<u>Cleveland</u>	
	<u>Capital<sup>2</sup></u>	<u>O&amp;M</u>	<u>Capital</u>	<u>O&amp;M</u>
	<u>\$1000/mgd</u>	<u>\$/MG</u>	<u>\$1000/mgd</u>	<u>\$/MG</u>
Primary and Secondary	367	60	420	76
Phosphorus Removal <sub>3</sub>	118	50	10	45
Nitrification & Denitrification	136	35	106	38
Mixed Media Filtration	49	15	47	18
Carbon Adsorption	165	68	175	45
Post Aeration	6	10	12	10
Chlorination	<u>4</u>	<u>4</u>	<u>10</u>	<u>8</u>
TOTAL	845	242	780	240
Chicago Plant with Phosphorus removal used in Cleveland Plant	737	237	780	240

- 1.) Reference: Regional Wastewater Management Systems for the Chicago Metropolitan Area, Technical Appendix, Office of the Chief of Engineers, Department of the Army, March, 1972.
- 2.) Capital Costs from the Reference were adjusted from an ENR of 1850 to 1740.
- 3.) The Chicago report used a tertiary process for phosphorus removal whereas the Cleveland report incorporated phosphorus removal into the secondary plant.

**TABLE 5**  
**PHYSICAL-CHEMICAL TREATMENT PLANT (LEVEL 2)**

	<u>Chicago<sub>1</sub></u>		<u>Cleveland</u>	
	<u>Capital<sub>2</sub></u> <u>\$1000/mgd</u>	<u>O&amp;M</u> <u>\$/MG</u>	<u>Capital</u> <u>\$1000/mgd</u>	<u>O&amp;M</u> <u>\$/MG</u>
Phosphorus Removal <sub>3</sub>	118	50	110	82
Carbon Adsorption	165	68	175	45
Mixed Media Filtration	49	15	47	18
Post Aeration	6	10	-	-
Ammonia Removal	150	72	-	-
Chlorination	4	4	-	-
Downflow Carbon	-	-	83	23
Breakpoint Chlorination	-	-	10	47
Ozonation	-	-	34	31
TOTAL	492	219	459	246

1.) See Note 1, Table 4.

2.) See Note 2, Table 4.

3.) Same as Coagulation and Sedimentation in the Cleveland Study.

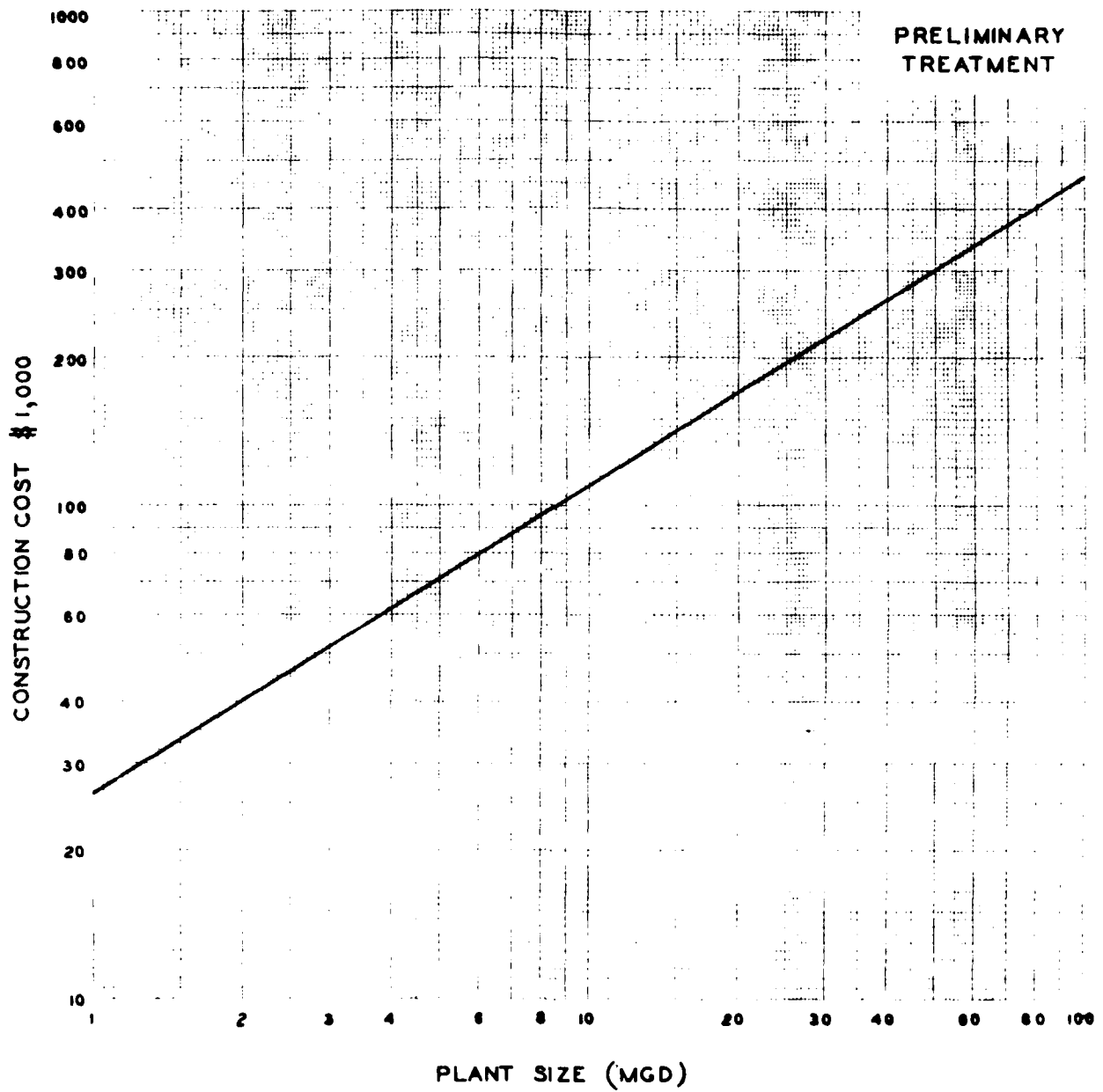


Figure No. 33

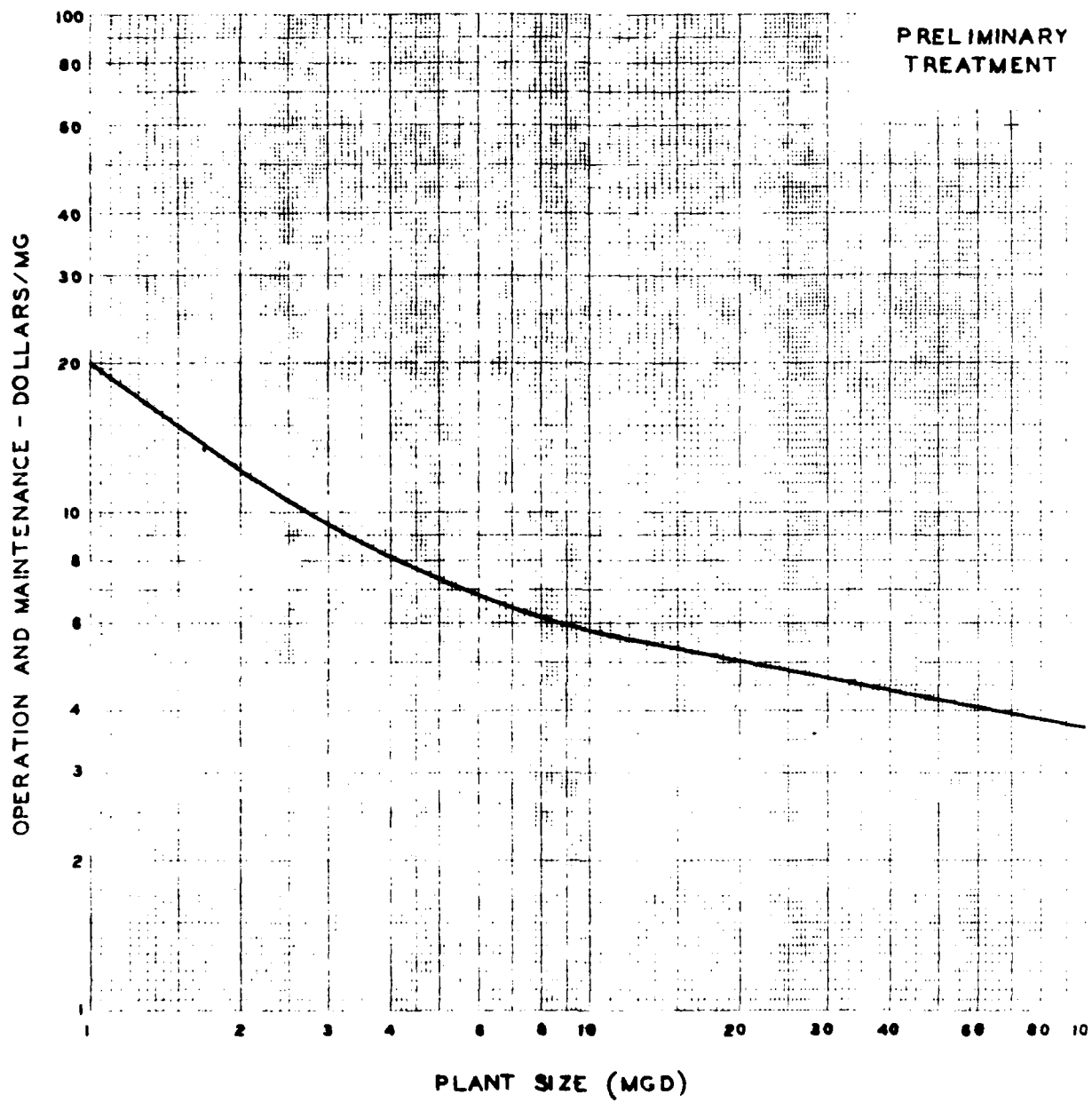


Figure No. 33A

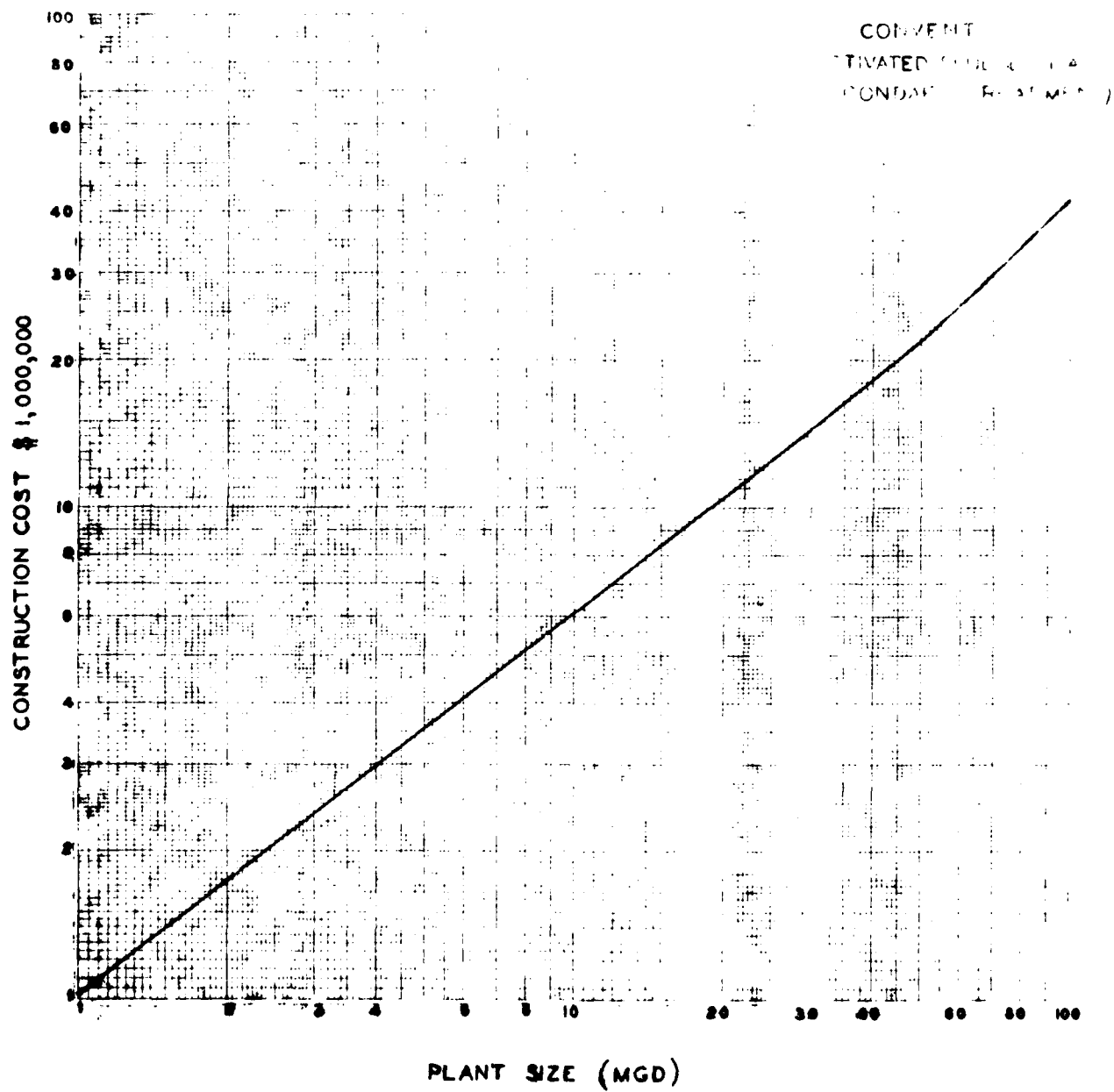
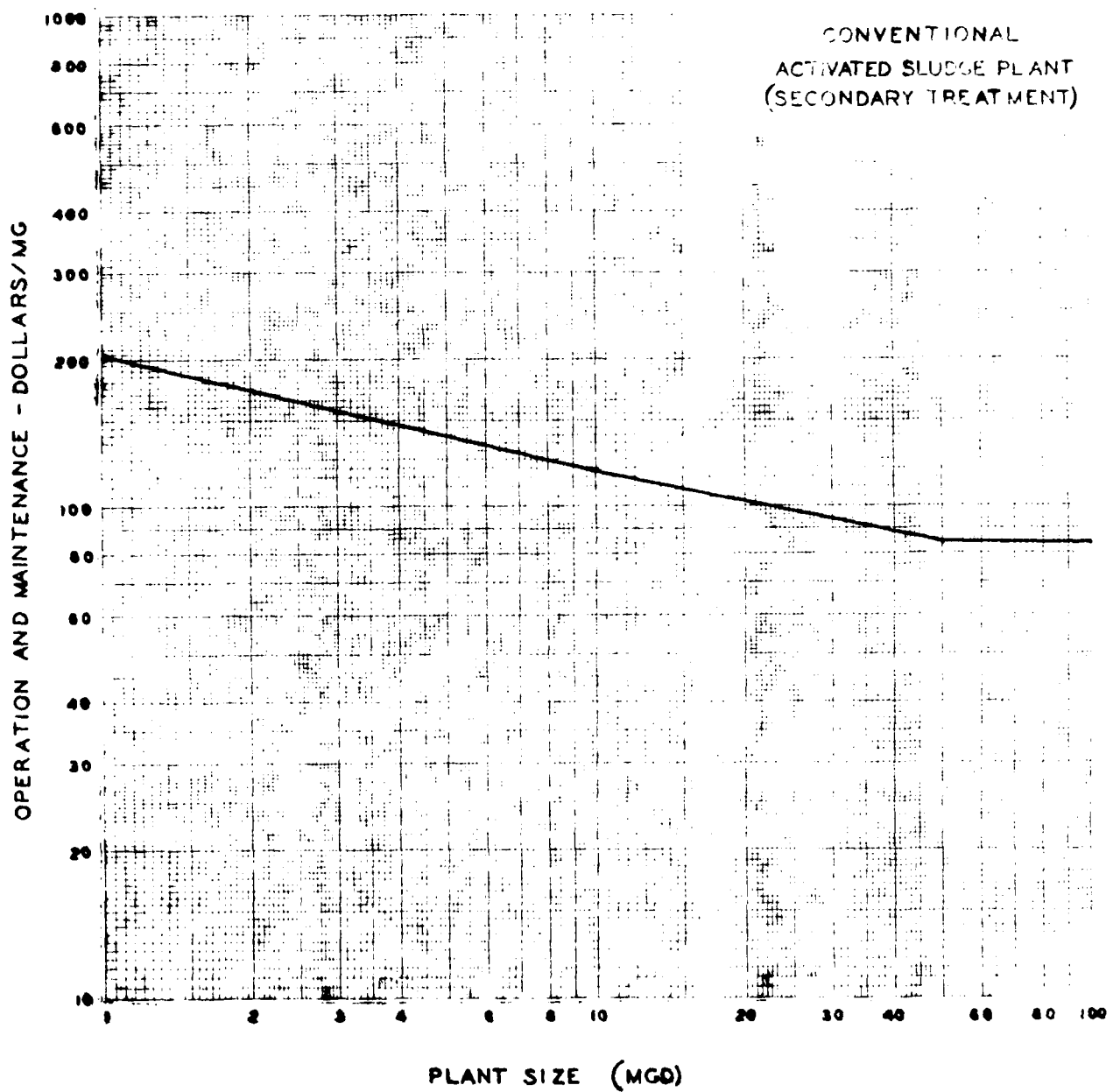


Figure No. 34



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HAVENS AND EMERSON LTD CLEVELAND OH  
WASTEWATER MANAGEMENT STUDY FOR CLEVELAND-AKRON AND THREE RIVER--ETC(U)  
AUG 73

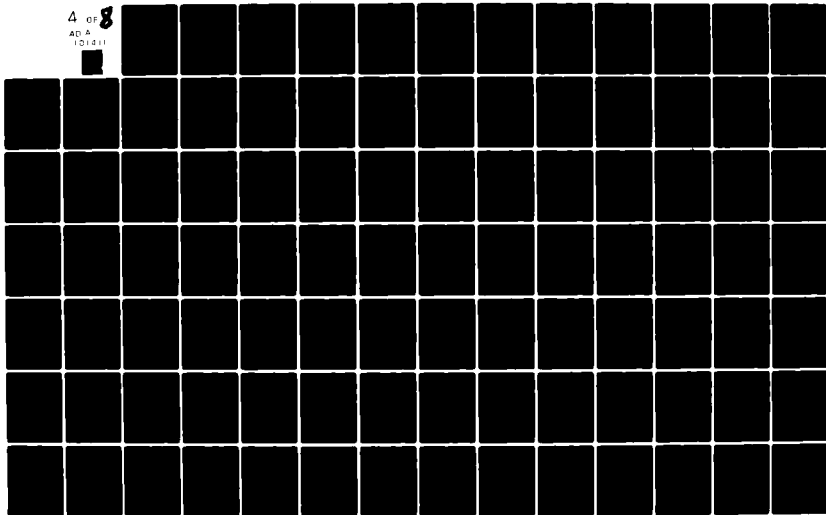
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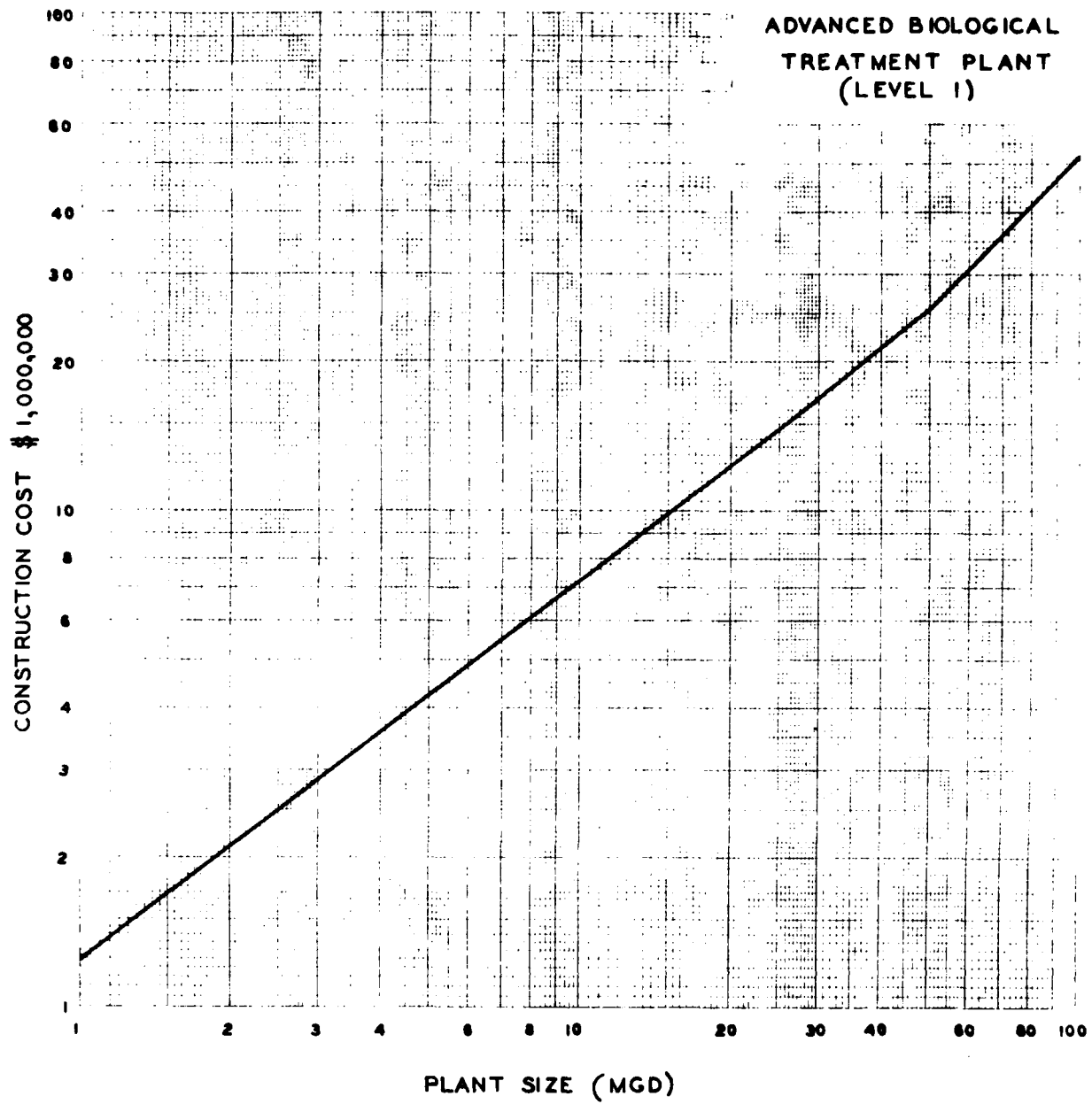


Figure No. 35

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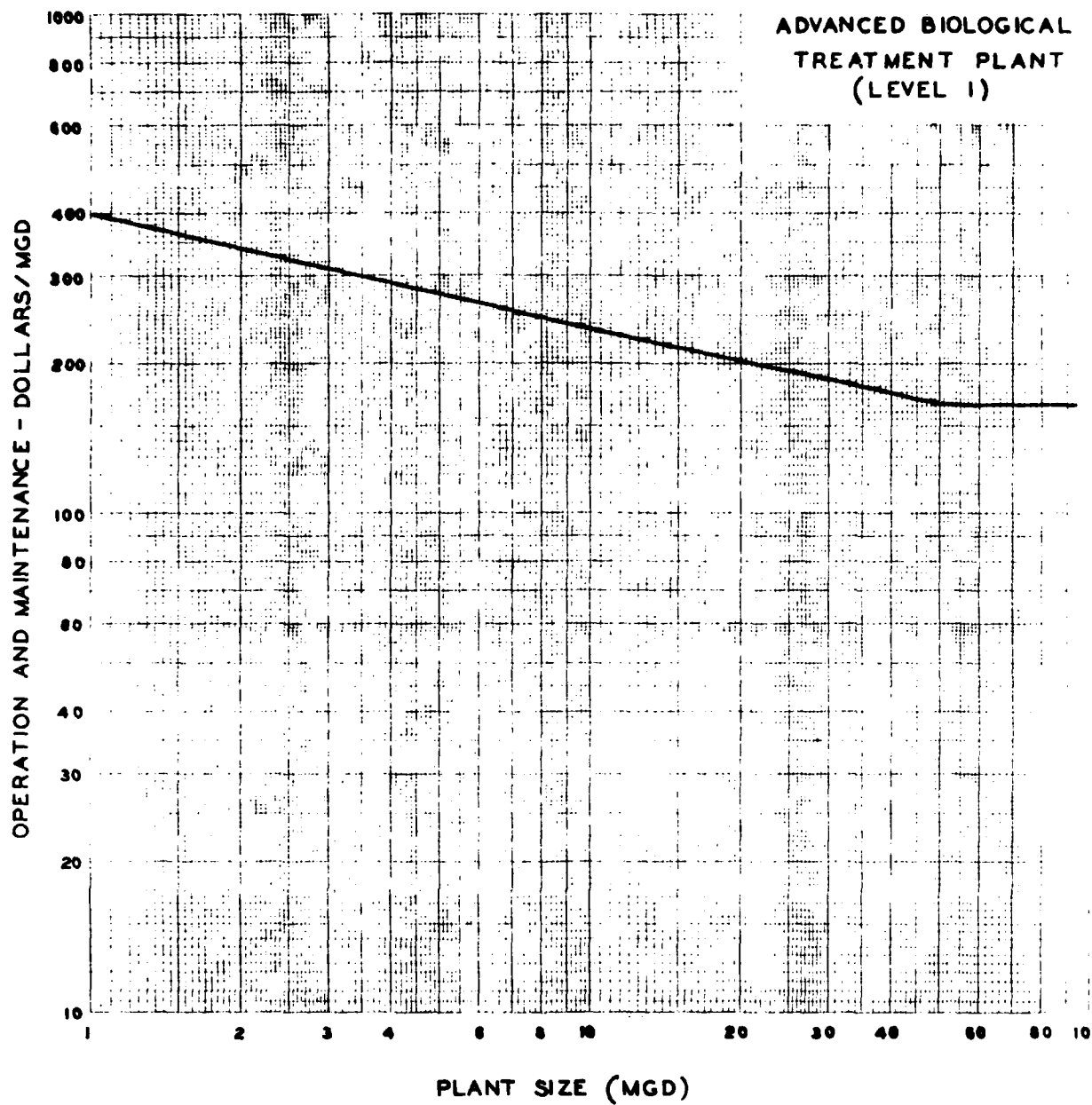


Figure No. 35A

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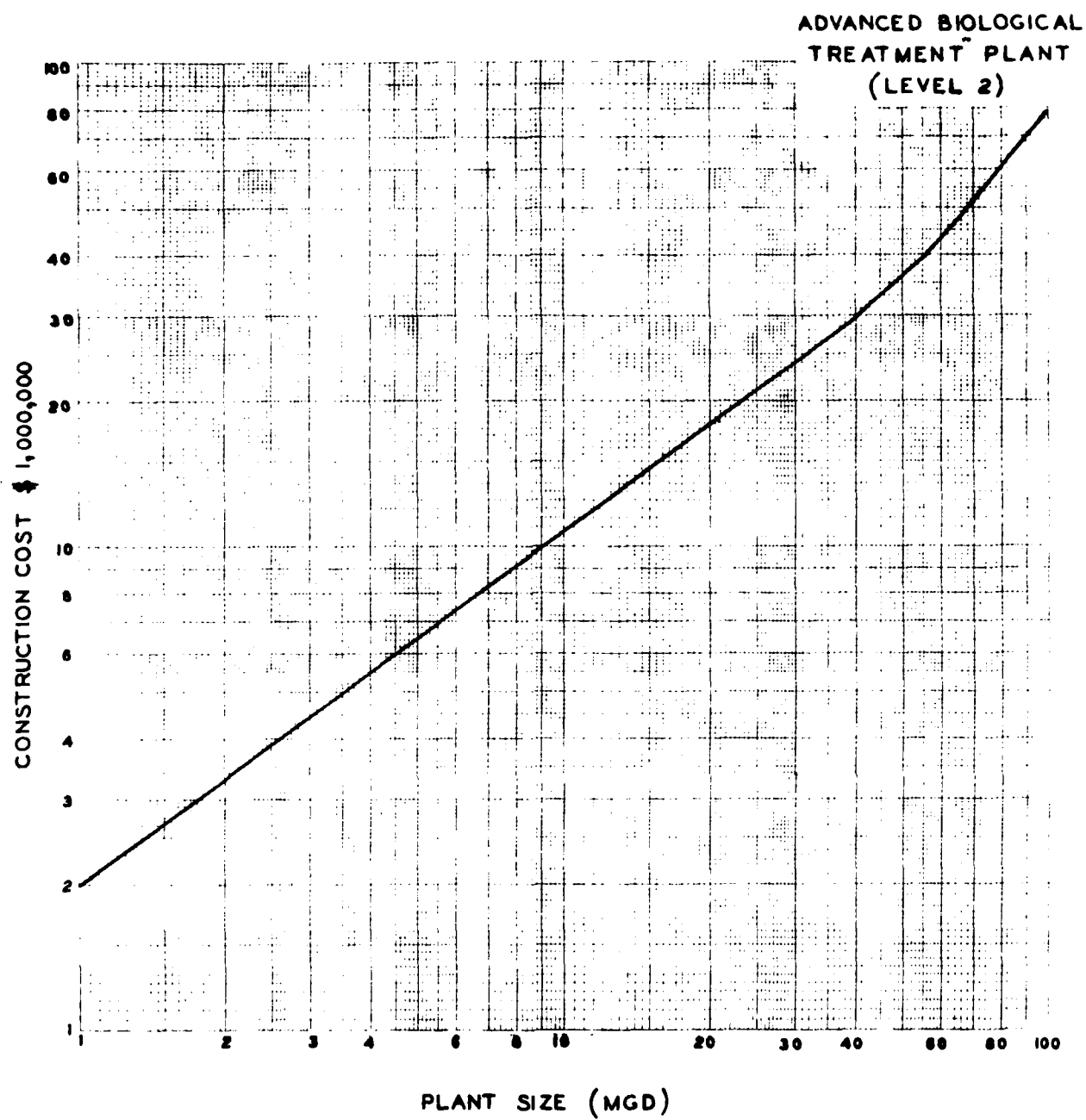


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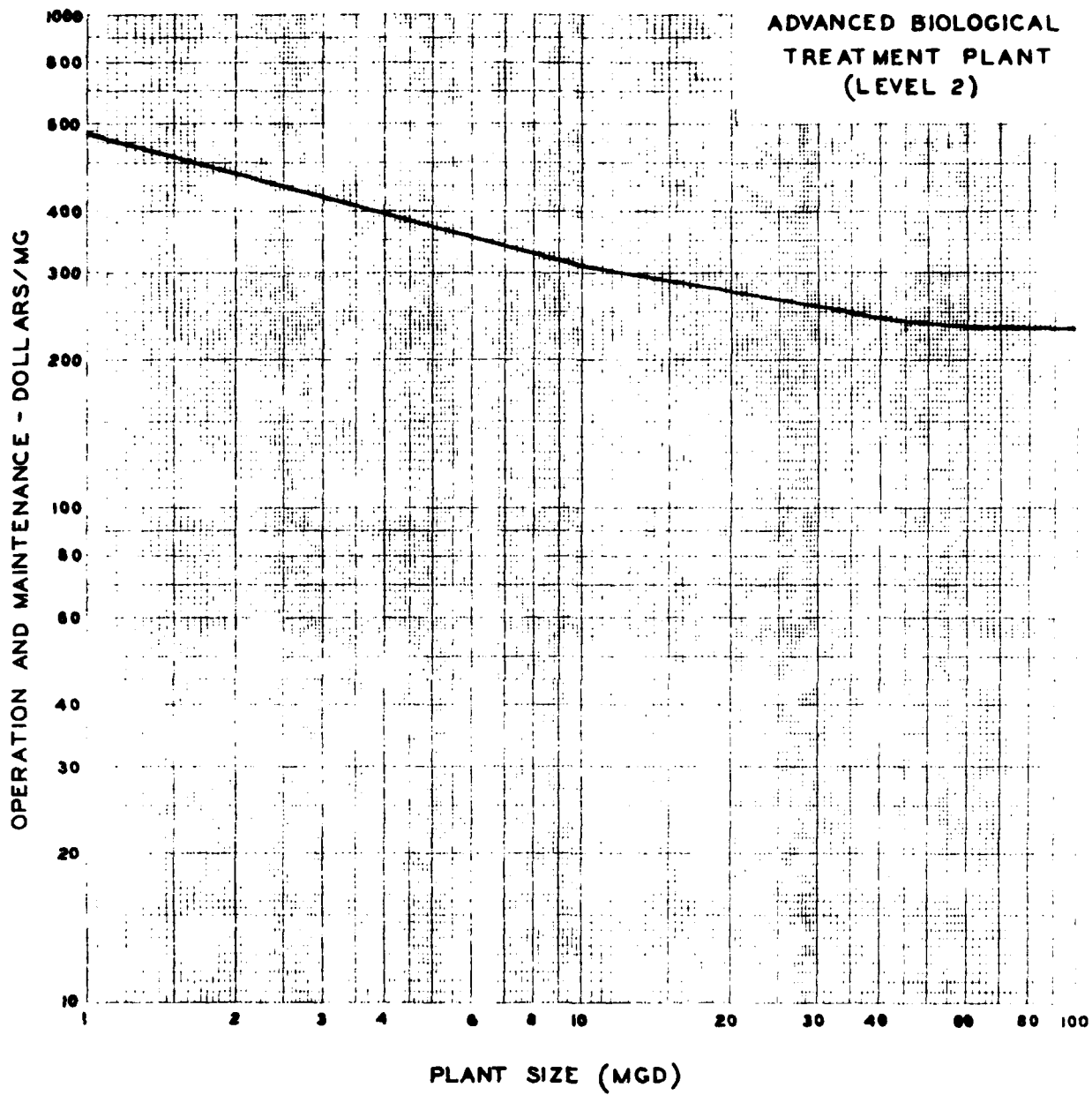


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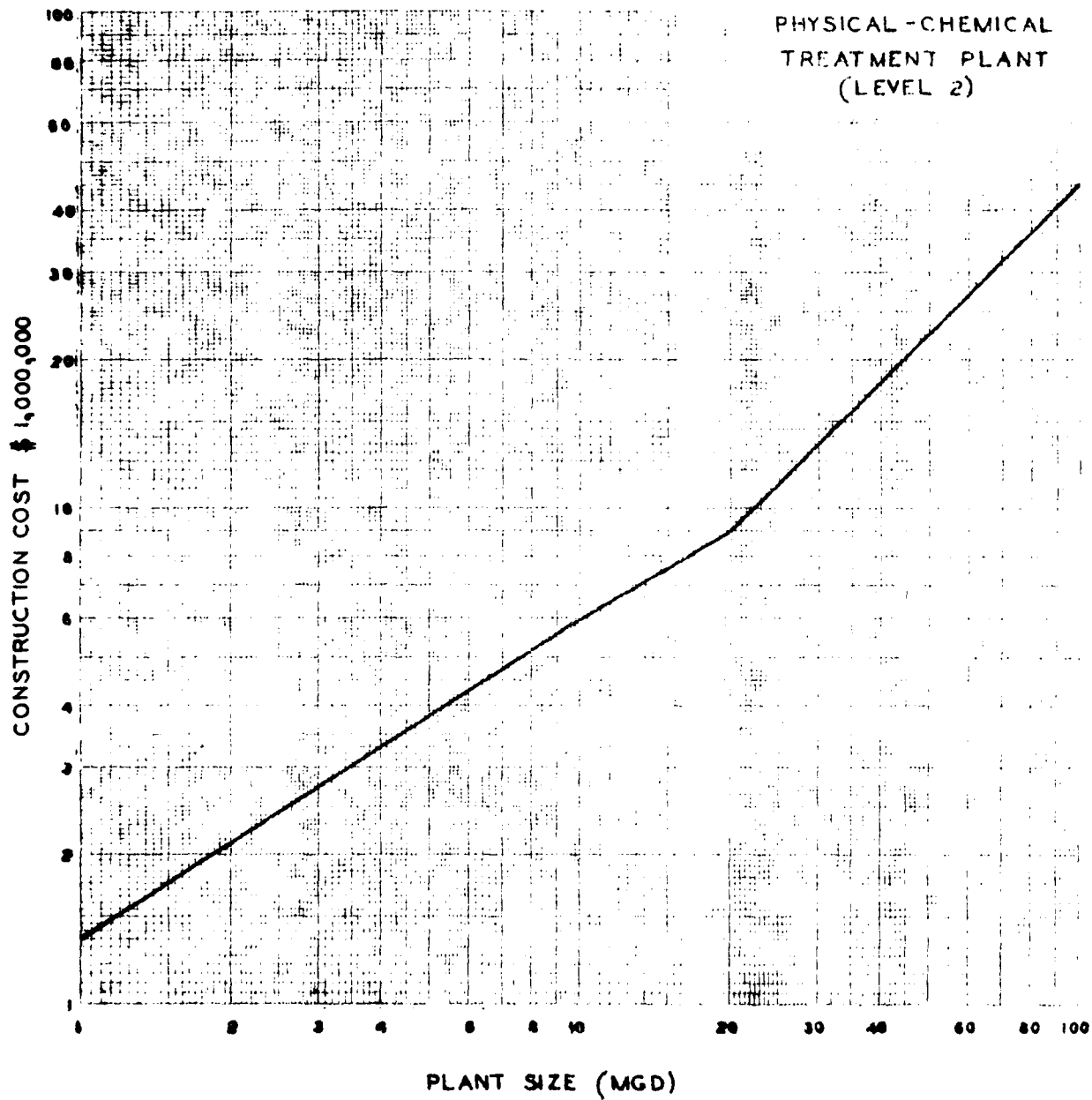


Figure No. 37

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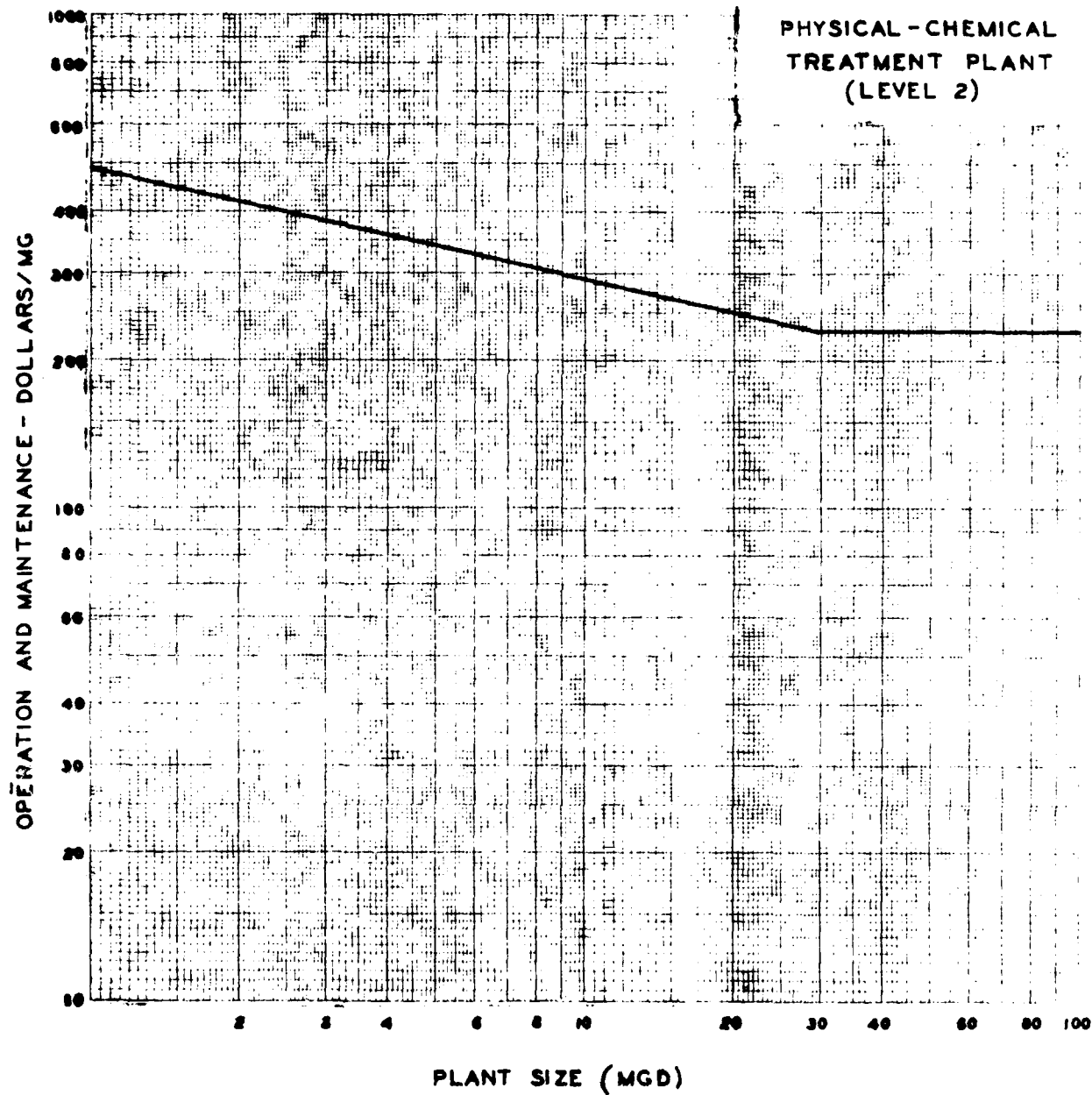


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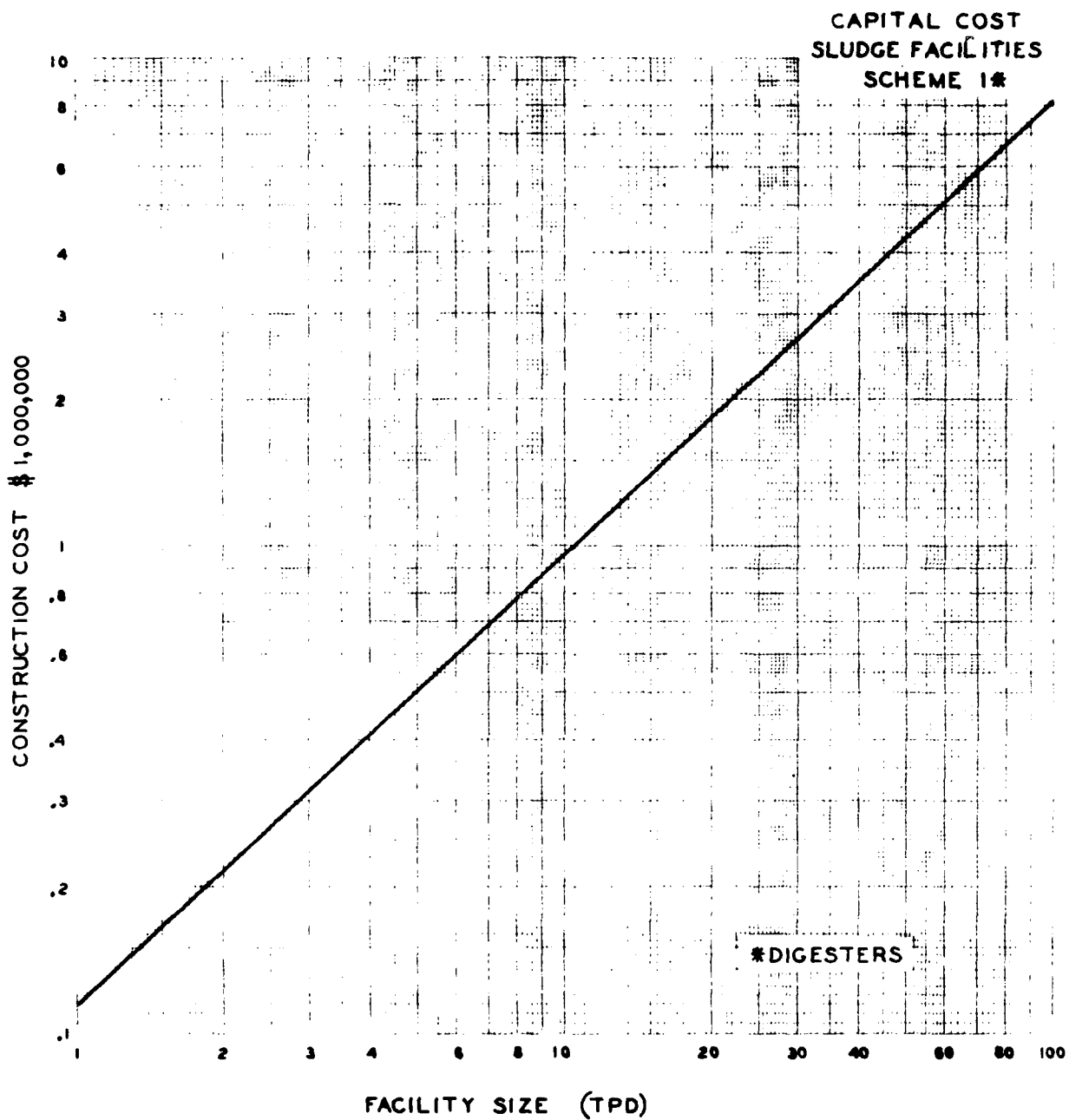


Figure No. 38

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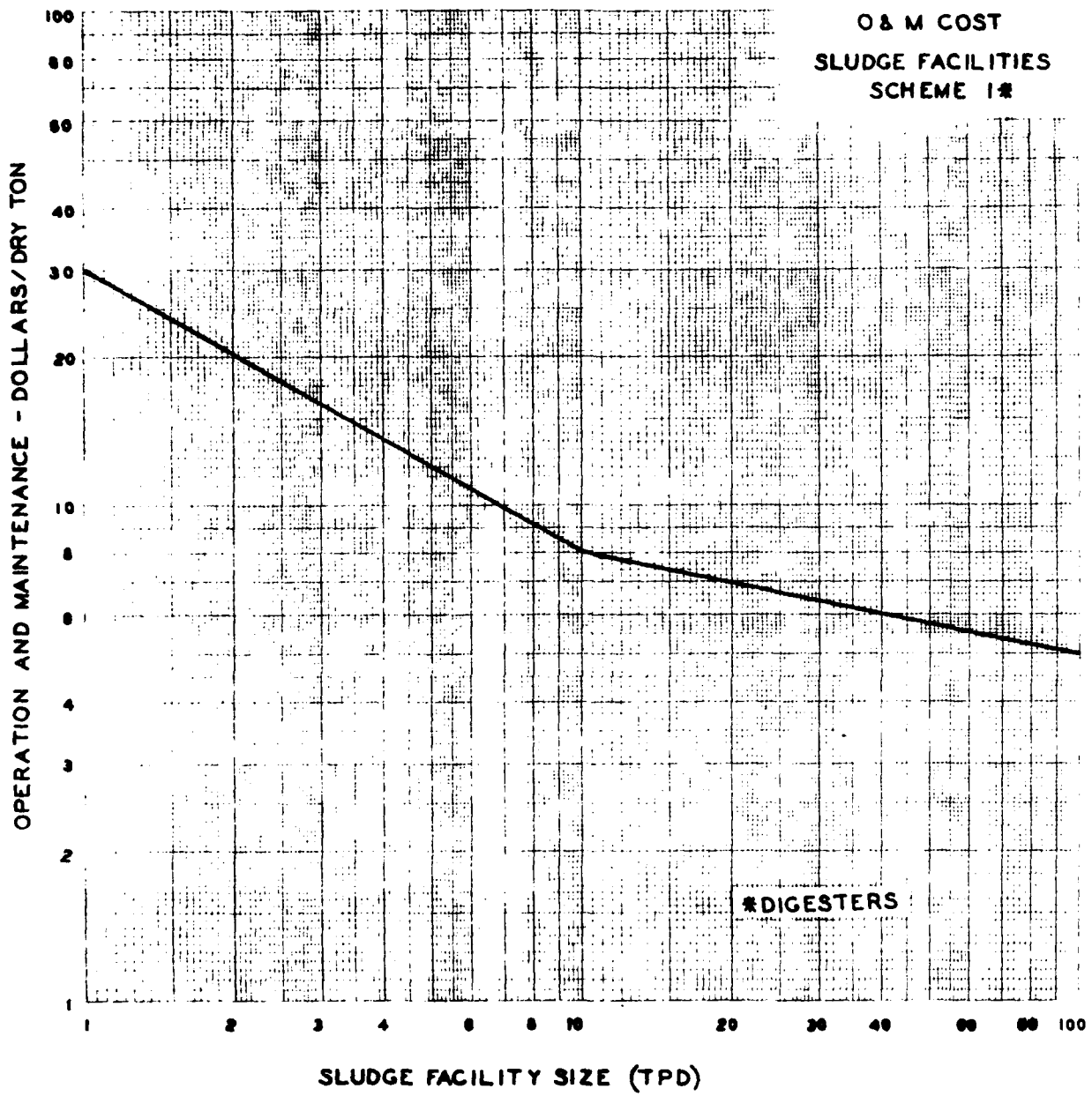


Figure No. 38A  
A108

CAPITAL COST  
SLUDGE FACILITIES  
SCHEME 2\*

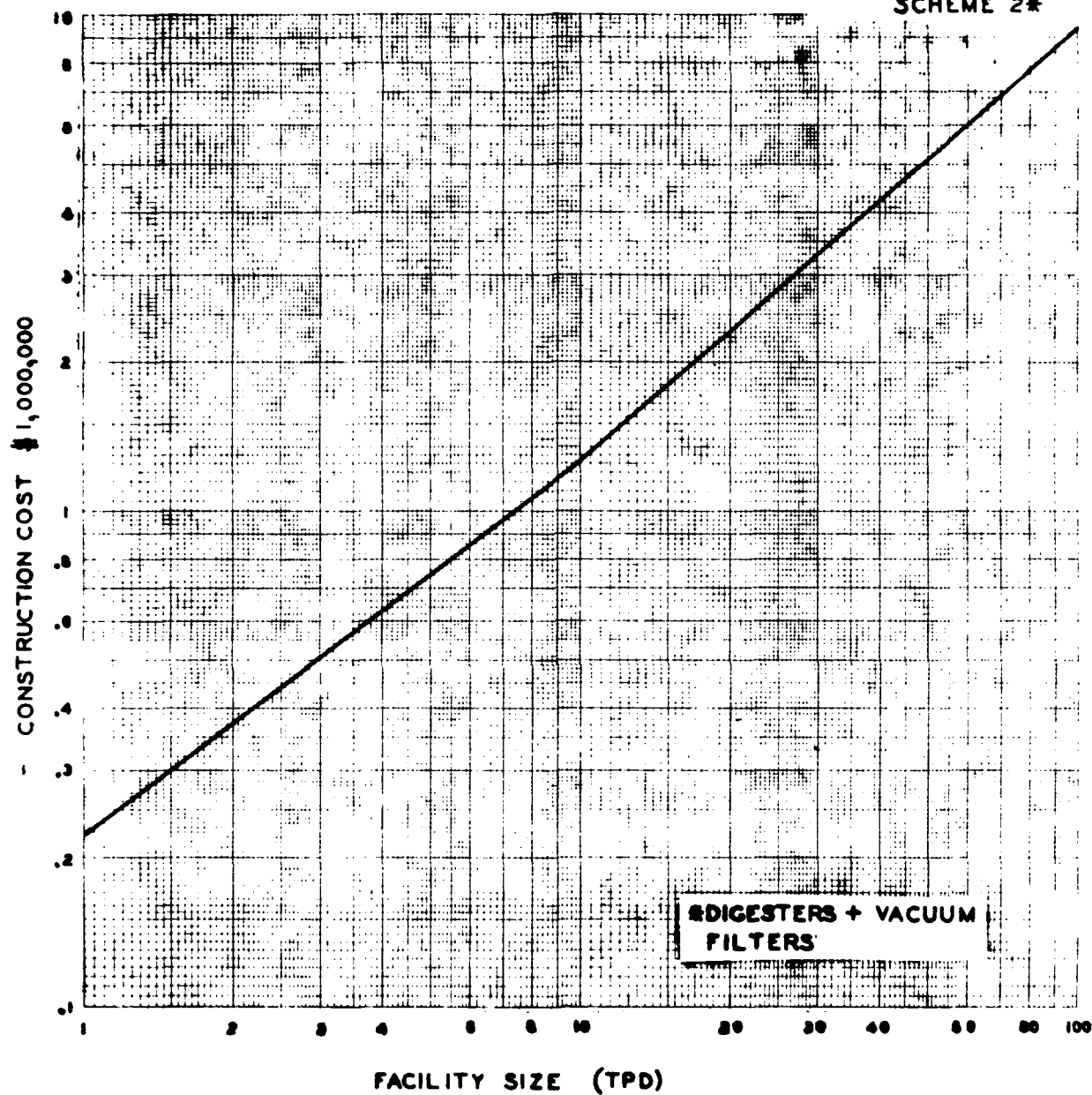


Figure No. 39

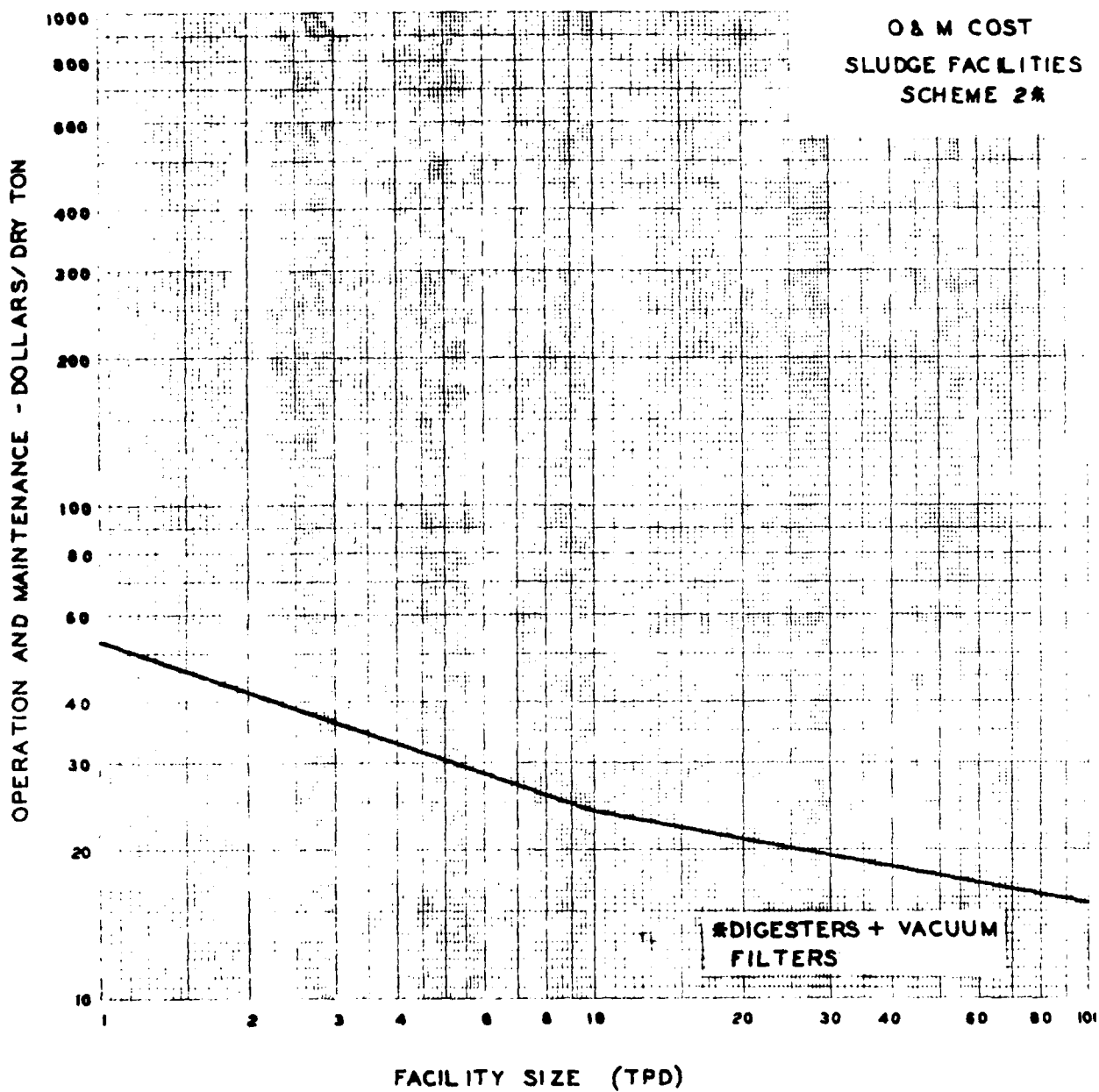


Figure No. 39A

AHC

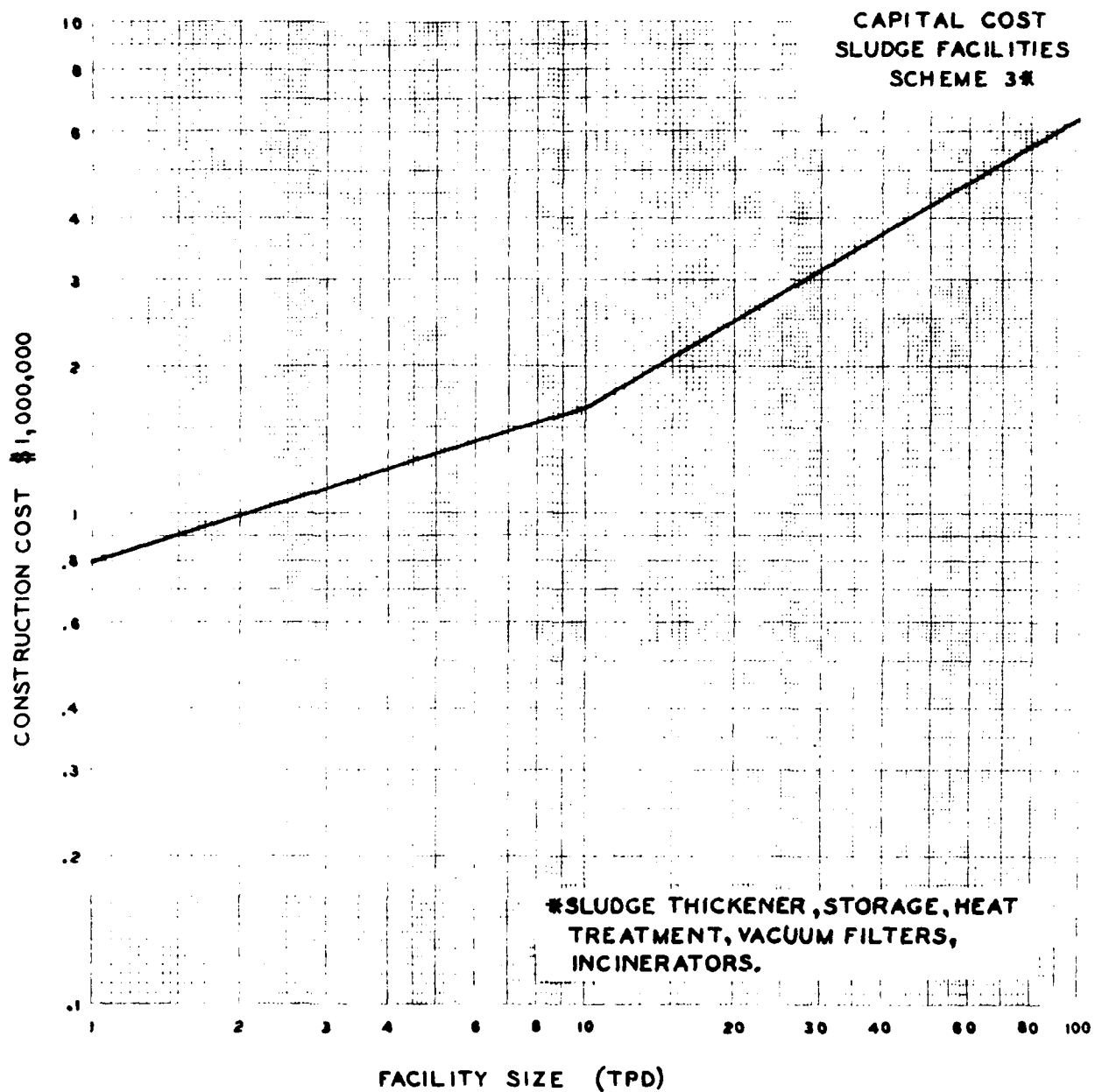


Figure No. 40

A111

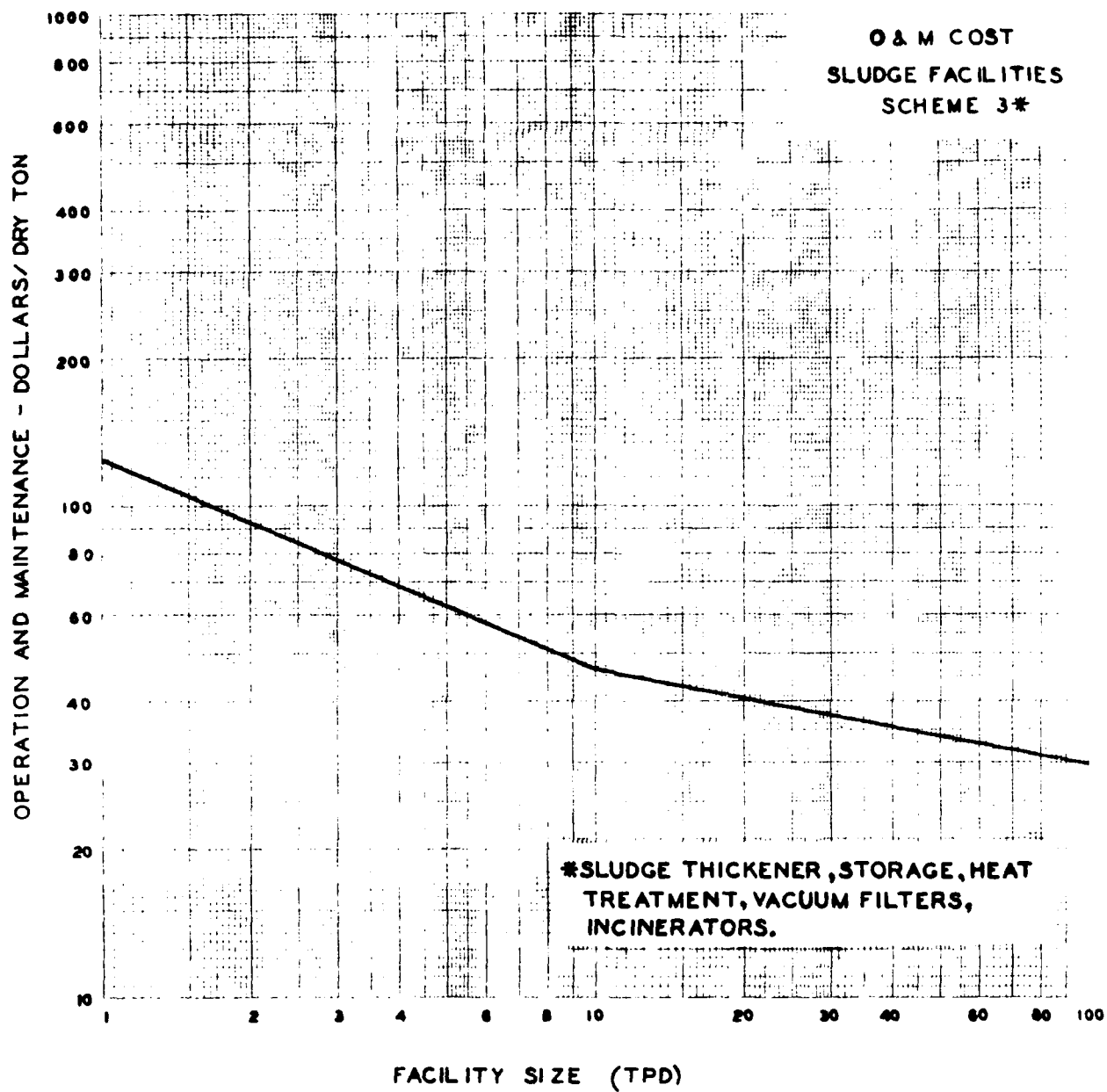


Figure No. 40A

A112

## B - STORMWATER RUNOFF

This section of the Phase II report discusses the treatment of urban stormwater runoff as part of the total wastewater management study. The wastewater management goals for stormwater are the same as defined in the wastewater section for the O.C.E. goals; however, for the State goals, screening and sedimentation followed by microstraining and disinfection were established to be adequate. The State or Level 1 stormwater effluent quality criteria is different from wastewater due to the character of the constituents of runoff. A large percentage of the suspended solids in stormwater runoff would be categorized as inert suspended solids for which the State allowable concentrations can be satisfied by the unit processes considered.

### 1. TREATMENT PROCESSES AND EFFECTIVENESS

Stormwater runoff flows are intermittent and have high peak rates. Quality of storm runoff varies widely during the storm and from one storm to another because of the hydrologic factors involved, such as percentage of imperviousness of the drainage area, rainfall intensities and duration and antecedent rainfall. A feasible treatment process requires a storage basin to reduce the peak rates so that treatment units may be sized for lower rates of flow. It is also economical to utilize the storage basin for sedimentation in order to capture a substantial part of suspended solids, BOD and other pollutants. The storage basin will serve also as a means to mix the stormwater and produce a more homogeneous mixture which approaches the average quality assumed for design.

#### 1.1 PROCESS CONSIDERATIONS

Process considerations for stormwater treatment facilities include the following:

- (a) Hydraulic surge control and storage to reduce instantaneous maximum hydraulic rates to treatment;
- (b) Capability of providing immediate service at or near maximum efficiency with low degree of operator attention;
- (c) Avoidance of substantial inventory in idle capital equipment, i.e., maximize flow dependent operating expenditures;
- (d) Self-contained process sequence exclusive of solids disposal.

## 1.2 STORMWATER RUNOFF TREATMENT SYSTEMS

As a function of the stormwater source, treatment systems and their rationale are presented herein.

### 1.21 LEVEL 1 - SEPARATE STORMWATER RUNOFF TREATMENT SYSTEM

Figure B1 shows a schematic diagram for separate stormwater treatment to Level 1. The process includes: coarse screening, storage and sedimentation basin (which may be earth or concrete), and a pumping station to pump stormwater from the basin to a microstrainer installation. Disinfection of stormwater by ozonation follows before flow is finally discharged to streams, rivers or Lake Erie. Microstrainer backwash is treated by sedimentation. Earth basins will normally include three cells to provide for periodic sludge removal by bulldozing and trucking or piping to landfills or the central sludge disposal site. Concrete basins will be provided with mechanical sludge collectors, and sludge will be pumped to a central sludge disposal site.

### 1.22 LEVEL 1 - COMBINED SEWER OVERFLOW TREATMENT SYSTEM

Figure B2 shows a schematic for combined sewer overflows treatment to Level 1. This process is similar to that of Figure B1, described above. The storage sedimentation basin will be concrete with mechanical sludge collectors in all cases. Combined sewer areas are highly urbanized with limited available land, and combined overflows have higher BOD concentration than separate stormwater.

### 1.23 LEVEL 2 - SEPARATE STORMWATER RUNOFF TREATMENT SYSTEM

Treatment of separate stormwater largely reduces to one of particulate solids control and disinfection. However, to meet the proposed Federal effluent BOD<sub>5</sub> and COD standard, soluble organic removal must be provided. The proposed treatment sequence is schematically shown in Figure B3\* with its performance illustrated in Figure B3A\*.

The pretreatment, and storage and sedimentation tank are the same as contained in the systems designed to meet the proposed State effluent standards. Sequentially, in the flash mix and flocculation facilities, powdered activated carbon, alum, and polymer are added in flow dependent dosages. The powdered activated carbon (with a cost of about 1/3 the granular activated carbon) is applied to remove the majority of soluble organics; its use was selected to minimize the idle granular activated carbon inventory and minimize the required carbon contacting time in the subsequent downstream filtration process. Alum is added as a primary coagulant. Some precipitation of soluble phase phosphorus would be predicted. The organic polymer is applied as a secondary coagulant for its floc building and strengthening properties. The long detention time and low surface overflow rate of the storage/sedimentation tank should result in an effluent with low suspended solids.

The downflow dual media granular activated carbon-sand filter will provide further soluble organic removal with effluent suspended solids residuals at a point acceptable to the proposed Federal effluent standards. Backwashing will most likely not be required during stormwater treatment and will normally be conducted following a storm with an ozonated backwash stream to remove accumulated solids and "sterilize" the bed so that bacterial activity is at a minimum during idle conditions. An alternative to this mode of operation would be to aerate the carbon bed during idle operation to promote bacterial removal of the adsorbed organics, and thus, achieve some microbial regeneration of the carbon. Spent or exhausted carbon is to be trucked and regenerated at

\*Federal Goals refer to standards established by O.C.E.  
(Office of the Chief of Engineers).

the furnaces contained at the regional wastewater treatment plant.

Ozonation is provided for disinfection and final organic polishing or removal prior to discharge into the receiving body of water.

#### 1.24 LEVEL 2 - COMBINED SEWER OVERFLOW TREATMENT SYSTEM

Combined sewer overflow treatment presents the same technical problems as municipal wastewater treatment except that it is somewhat more dilute. System hydraulic loads vary rapidly from zero to peak rate as influenced by the storm intensity and runoff characteristics of the service area. Rather than substantially oversize the main wastewater treatment facility, a treatment facility that could complement or operate at an isolated location is proposed. Such a system is shown schematically in Figure B4 with its performance illustrated in Figure B4A. In situations where the combined sewer overflow treatment system is contained on the same physical site as the municipal wastewater treatment plant, the latter would be operated at its peak capacity during the storm with the stormwater treatment installation to reduce costs.

As shown in Figures B4\* and B4A\*, the only additional unit process for this treatment system as compared to the sequence proposed for separate stormwater runoff is breakpoint chlorination for nitrogen removal. Excluding the polymer application, powdered activated carbon and alum dosages have been increased for higher organic and phosphorus removal, respectively. A lower polymer application is possible because of the higher dosage of alum for phosphorus precipitation. Lime addition in both the flocculation and breakpoint chlorination systems is for alkalinity control. The granular activated carbon filter follows breakpoint chlorination to remove any chlorinated hydrocarbons that may have been formed during breakpoint; no real organic removal is assumed to result with this operation.

\*Federal Goals refer to standards established by O.C.E.  
(Office of the Chief of Engineers).

# 1.25 LEVEL 1 and LEVEL 2 - SEPARATE OR COMBINED SEWER RUNOFF

## TREATED IN MUNICIPAL PLANTS

As discussed in the wastewater design criteria section, the unit processes are designed to treat flows greater than average. During the course of a day, the sanitary flow will fluctuate from a minimum which usually occurs in the early morning hours to a maximum which usually occurs at mid-day. Likewise, the flow in the sewers fluctuates by similar cycle. Under the concept of treating storm or combined sewer runoff in a municipal plant, the runoff water would be stored in storage basins and discharged into the sewer systems and carried to the plant during the hours of low flow.

Storage under this scheme becomes a significant cost because of the volume of runoff water to be treated. The rate at which this can be released into the municipal system is a function of the plant size. The question is how much storm water or combined overflow can be taken through the plant without upsetting the pollutant mass loading and decreasing the efficiency of the process? The control of the release would have to be routed such that the release from storage would not increase the flow above the peak design sanitary flow. The system would have to be flow monitored at several locations along the pipeline as well as at the plant itself. In systems with several storage basins releasing stored water, the system would undoubtedly have to be controlled by on-system-mini-computers and automatically controlled gates and variable speed pumps. The maximum rate of release is also a function of plant size as indicated below.

Plant Size as Defined by ADF MGD	Ratios		
	$\frac{Q \text{ MF}}{Q \text{ ADF}}$	$\frac{Q \text{ MDF}}{Q \text{ ADF}}$	$\frac{Q \text{ MF}}{Q \text{ MDF}}$
0- 5	3.00	1.5	2.0
5-10	2.85	1.5	1.9
10-15	2.70	1.5	1.8
15-20	2.55	1.5	1.7
20-25	2.40	1.5	1.6
Greater than 25	2.25	1.5	1.5

To compute the maximum flow that can be released, the following procedure was used:

Example: 100 mgd advanced biological plant.

ADF = 100 mgd

Max. Flow = 225 mgd

Max. Daily Flow = 150 mgd

Maximum Allowable Stormwater Release  $225 - 150 = 75$  mgd

Average Daily Flow with Stormwater  $100 + 75 = 175$  mgd

Several units within the treatment scheme must be enlarged to treat this increased flow. The increase in cost necessary to enlarge the unit processes is approximately a one-third increase in construction cost over the plant sized for the municipal average daily flow. The unit processes would remain the same. Operation and maintenance cost for the additional flow is the same as for domestic flow.

This particular scheme has several technical difficulties. First, it has not been attempted in plants with flows of this magnitude. Consequently, there is an unknown with regards to the efficiency of operation. Second, if storm water runoff does not need the same degree of treatment, there would be no way of separating the combined flows. Third, the expense of storm water collection and storage may make the construction of the system economically difficult and require a phasing of wastewater followed by stormwater at a later date. Fourth, the diversion of the water downstream to regional plants will reduce the flow in several reaches of streams and may completely dry up some small tributaries.

Consequently, the use of this technique in Phase III will require detailed consideration of a location and type of storage basin, size of wastewater treatment plant, and capacity and condition of existing sewer system.

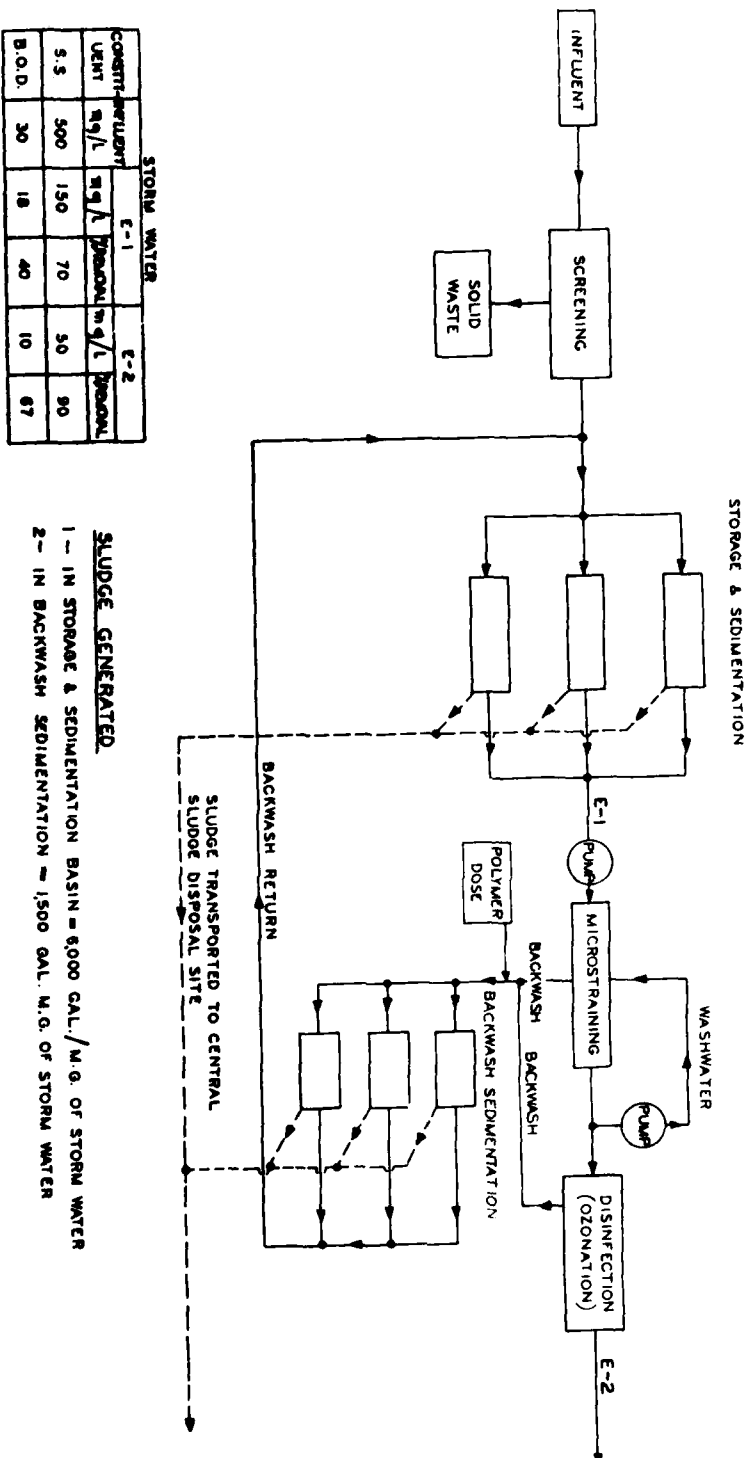
Table B1 presents the alternatives in condensed form.

TABLE B1

STORMWATER RUNOFF TREATMENT

ALTERNATIVES

<u>STORM</u>	<u>COMBINED</u>			
	<u>Level 1</u>	<u>Level 2</u>	<u>Level 1</u>	<u>Level 2</u>
a)	2 hour detention, concrete w/sludge collection & microstraining plus disinfection	a) 2 hour detention, concrete w/sludge collection & advanced stormwater treatment plant	a) 2 hour detention storage in concrete tank w/sludge collection followed by microstraining and disinfection	a) 2 hour detention storage in concrete tanks w/sludge collection followed by advanced stormwater treatment plant
b)	1 year storm storage 3 day release, earth w/o sludge collection microstraining and disinfection	b) 1 year storm storage 3 day release, earth w/o sludge collection advanced stormwater treatment plant	b) 2 hour detention concrete w/o sludge collection but solids suspension and pump to plant	b) 2 hour detention, concrete w/o sludge collection but solids suspension and pump to plant
c)	30-day storage earth and pump to plant	c) 30-day storage earth and pump to plant		
d)	30-day storage earth microstraining and disinfection and pump to land			

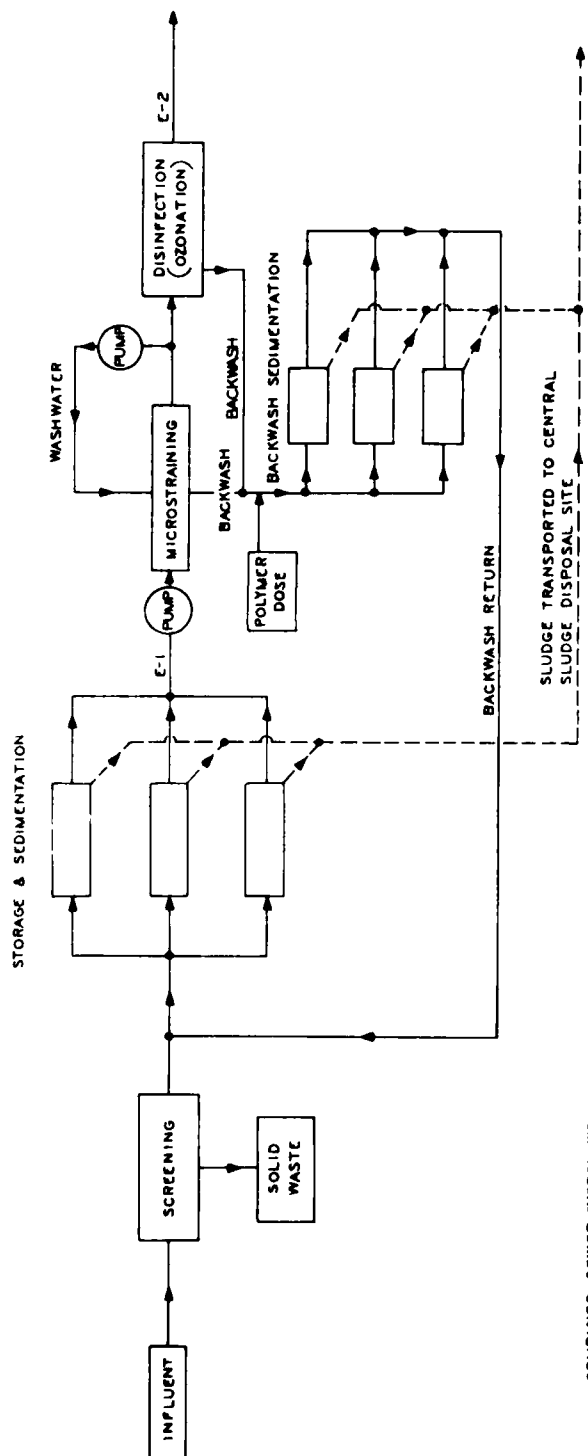


STORM WATER			
CONCENTRATION	E-1		E-2
UNIT	mg/l	mg/l	mg/l
5.5	500	150	70
			50
			90
B.O.D.	30	18	40
			10
			67

**SLUDGE GENERATED**  
 1 -- IN STORAGE & SEDIMENTATION BASIN = 6,000 GAL./M.G. OF STORM WATER  
 2 -- IN BACKWASH SEDIMENTATION = 1,500 GAL. M.G. OF STORM WATER

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FIGURE B.1  
 TREATMENT SYSTEM FOR STORM WATER  
 TO MEET STATE GOALS



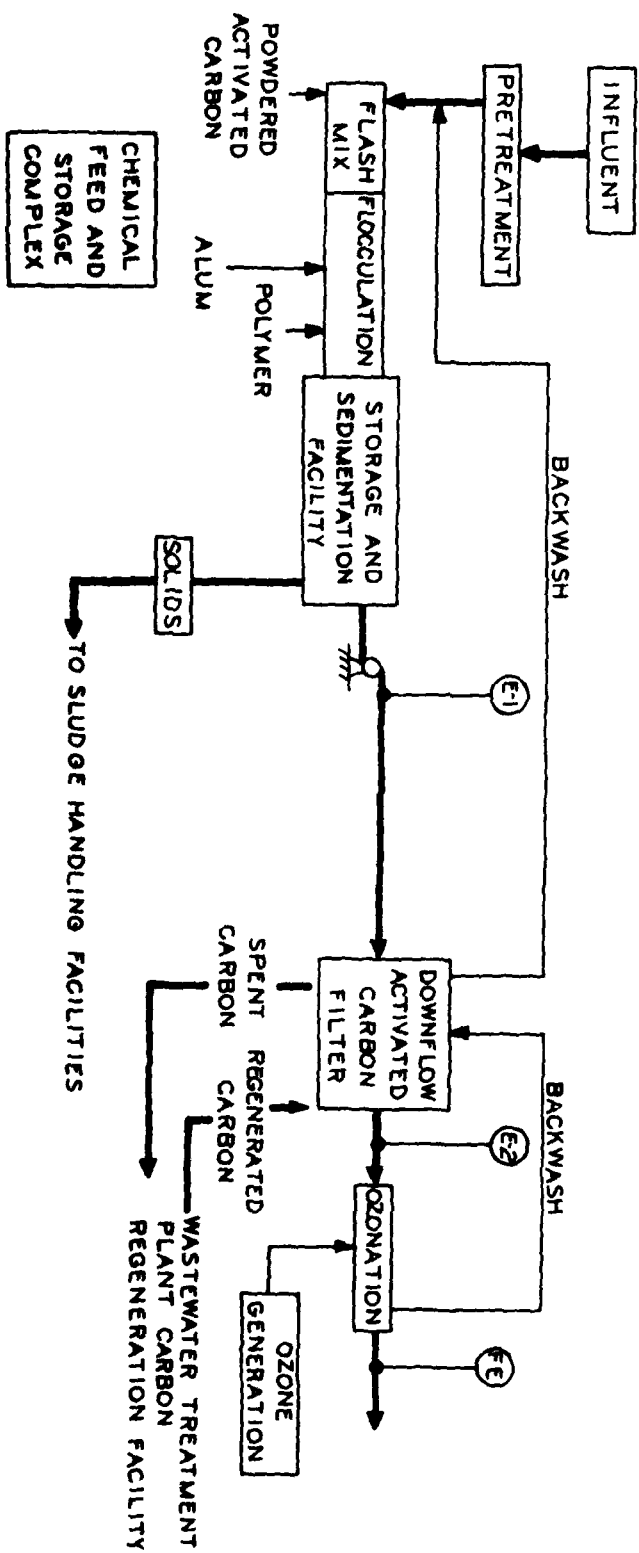
# SLUDGE GENERATED

- 1 - IN STORAGE & SEDIMENTATION BASIN = 2400 GAL. M.G. OF COMBINED SEWER OVERFLOWS
- 2 - IN BACKWASH SEDIMENTATION BASIN = 600 GAL. M.G. OF STORM WATER

## COMBINED SEWER OVERFLOWS

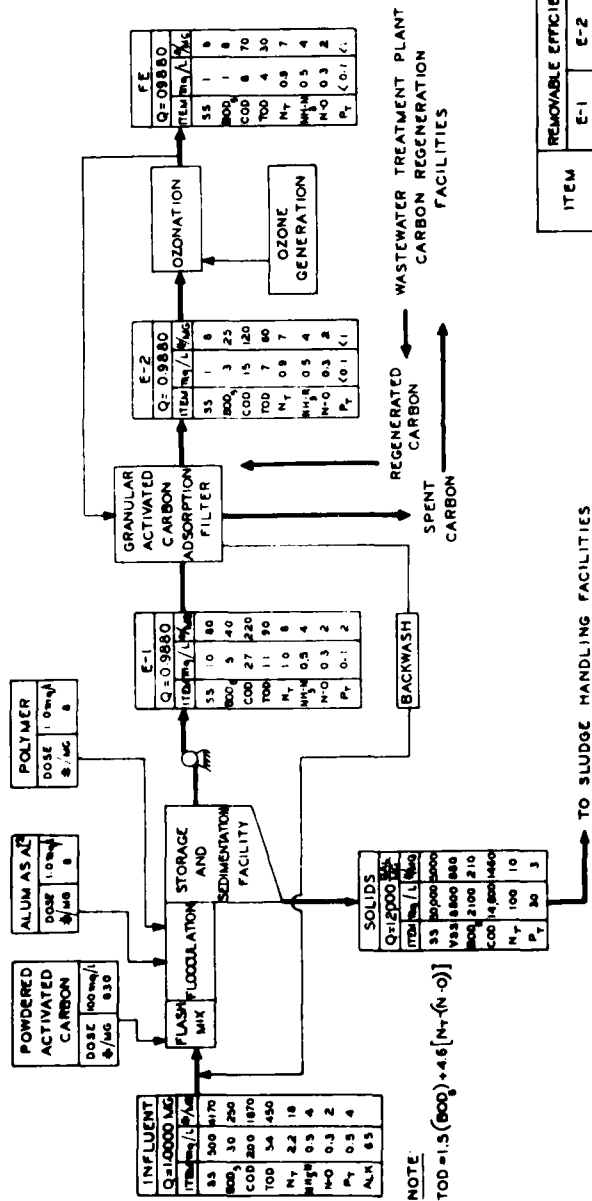
CONSTITUENT	mg/L	E-1		E-2	
		mg/L	mg/L	mg/L	mg/L
SS	200	80	70	30	85
BOD	60	36	40	10	83

FIGURE B2  
TREATMENT SYSTEM FOR COMBINED  
OVERFLOWS TO MEET STATE GOALS



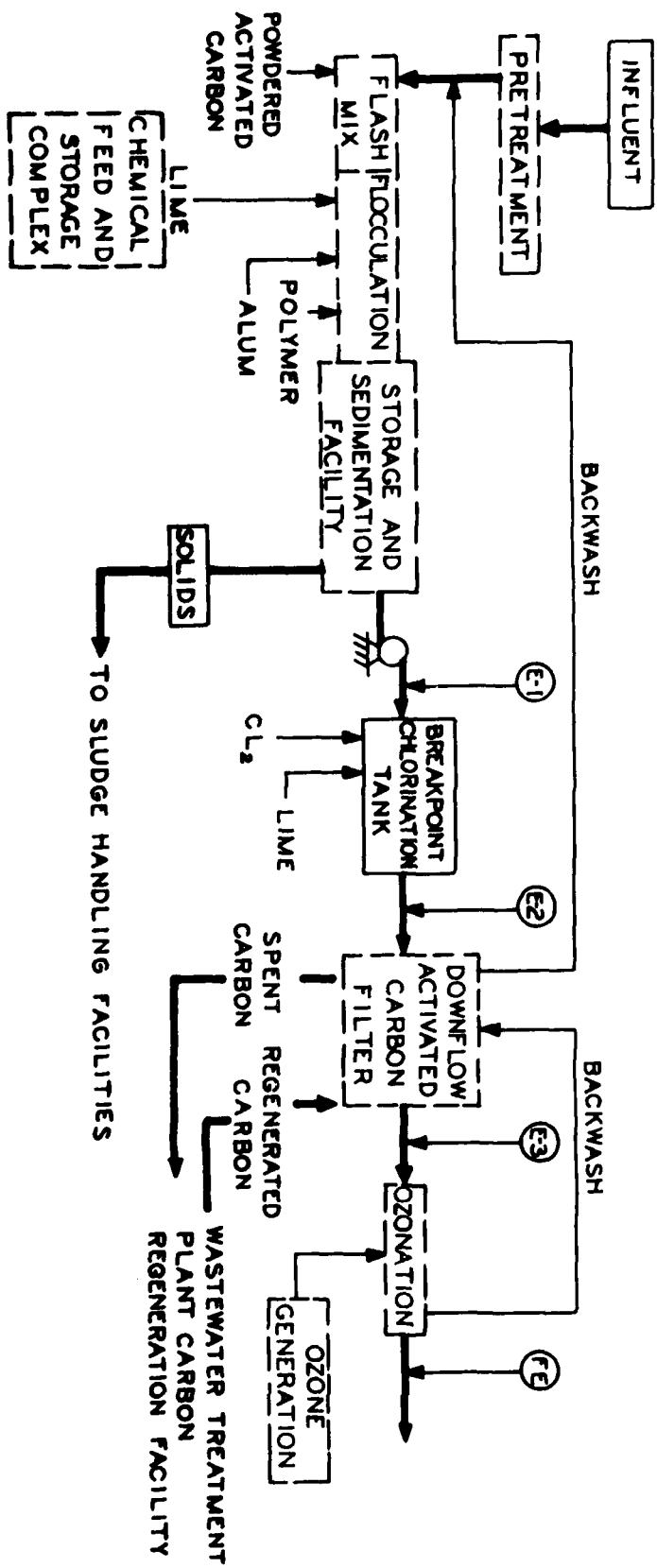
HAVENS AND EMERSON, LIMITED

FIGURE B.3  
BASIC PHYSICAL-CHEMICAL TREATMENT  
SYSTEM FOR STORMWATER TO MEET  
FEDERAL GOALS



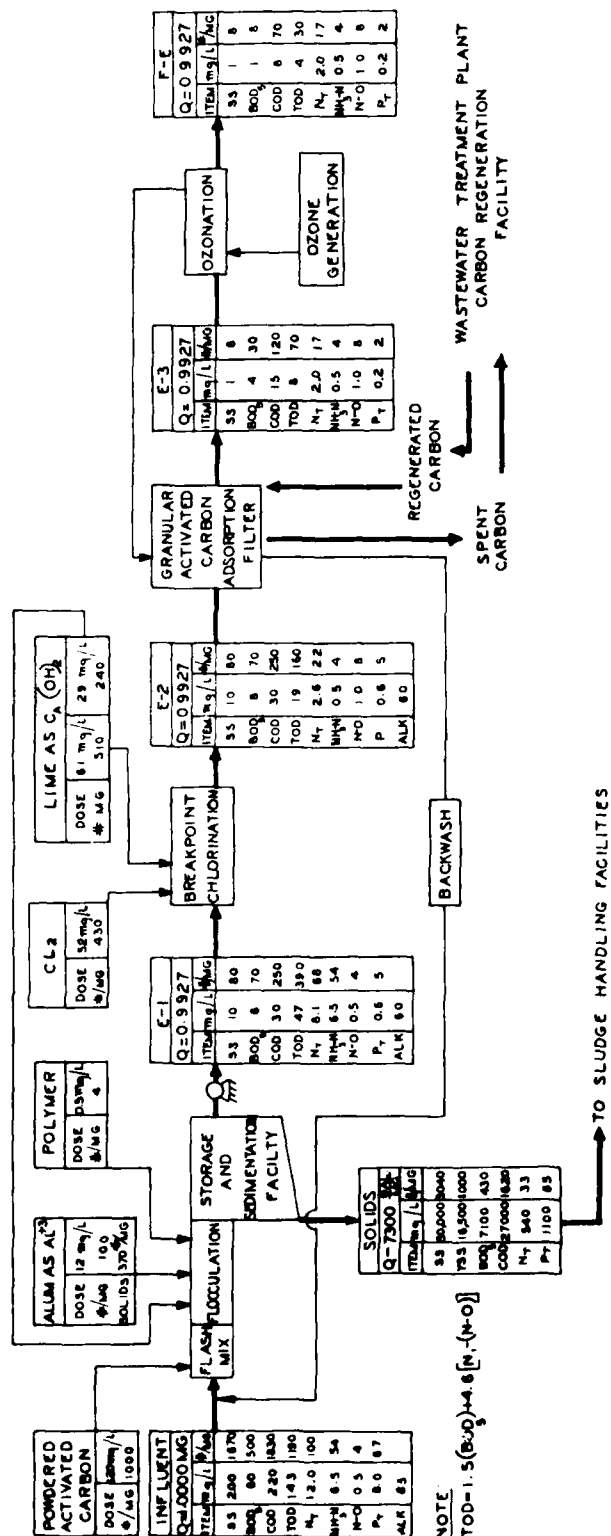
ITEM	REMOVABLE EFFICIENCIES- %		
	E-1	E-2	FE
SS	98	99+	99+
BOD <sub>5</sub>	83	90	97
COD	86	93	96
TOD	80	87	93
N	56	61	61
P	75	>75	>75

FIGURE B.3A  
 TREATMENT SYSTEM FOR STORM WATER  
 TO MEET FEDERAL GOALS



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FIGURE B 4  
BASIC PHYSICAL - CHEMICAL TREATMENT  
SYSTEM FOR COMBINED OVERFLOWS  
TO MEET FEDERAL GOALS B12



NOTE  
 TOD=1.5(BOD<sub>5</sub>)+4.6(N-O)

ITEM	REMOVAL EFFICIENCIES - %		
	E-1	E-2	E-3
SS	95	95	99+
BOD <sub>5</sub>	87	87	93
COD	86	86	93
TOD	67	87	94
N <sub>T</sub>	32	78	83
P <sub>T</sub>	93	93	97

FIGURE B.4A  
 TREATMENT SYSTEM OF COMBINED  
 OVERFLOWS TO MEET FEDERAL GOALS

## 2. DESIGN CRITERIA

The design criteria for the stormwater system is similar to the waste-water system. The unit processes or items that are different are presented herein.

### 2.1 COLLECTION

The collection system is that network of pipes required to pick up the local storm drains and deliver the water to the treatment plant or storage site. In areas where development is not sufficient to warrant a storm drainage system but where growth indicates the need at a later decade, the collection system was laid out to intercept the natural drainage patterns. The collection system was designed to carry the one year peak flow either natural or adjusted. The 2020 land use was used for the design. As discussed in the Phase I report, land use changes were accounted for. Further adjustments were made in undeveloped areas to account for changing development patterns and are discussed in Section 3.2.

### 2.2 ADJUSTMENT FOR PLANNED UNIT DEVELOPMENT ZONING

Stormwater flows can be reduced in future developments by appropriate planning if the concept of Planned Unit Development (P.U.D.) is adopted. The storm runoff from the developed portion of the area would be treated, whereas the runoff from the green space or recreational area would not be treated. This, of course, is different from the usual urban sprawl development in that the storm water from the occupied area would be physically separated. It was assumed that the P.U.D. concept would not be widespread until 1980. Only areas that have an imperviousness factor of 10% or less in 1980 would be available for P.U.D. construction. To account for a more dense development around cities, the projected imperviousness factor also had to be less than 40% in 2020.

Figure B5 illustrates the rationale used in the development of the modified runoff volumes. As the fraction impervious increases, the volume of runoff increases, from a theoretical  $Q_o$ , at zero fraction impervious.

$Q_o$  can be calculated as follows:

$$Q_o = Q_b - I_b \left( \frac{Q_b - Q_a}{I_b - I_a} \right)$$

$Q_o$  = Total annual runoff volume at zero fraction impervious

$Q_a$  = Total annual runoff volume for 1970 (m.g.)

$Q_b$  = Total annual runoff volume for 2020 (m.g.)

$I_a$  = Percent impervious for 1970 expressed as a decimal

$I_b$  = Percent impervious for 2020 expressed as a decimal

Assuming that the total runoff will be treated when an area reaches 0.40 fraction impervious it can be seen that the runoff from the undeveloped portion will decrease from  $Q_o$  to zero at 0.40 fraction impervious. Knowing this, the total runoff which must be treated,  $Q_m$ , can be calculated:

$$Q_m = I_b \left[ 2.5Q_b + \left( \frac{Q_b - Q_a}{I_b - I_a} \right) (1 - 2.5I_b) \right],$$

$Q_m$  = Modified annual runoff volume to be collected and treated in 2020 (m.g.).

### 2.3 STORAGE SEDIMENTATION BASIN WITH SEPARATE TREATMENT FACILITIES

Under the plans with separate treatment facilities, the storage sedimentation basins are of either concrete or earth construction. Concrete basins are assumed in urban areas where land is at a premium and a public nuisance or hazard exist. The earth storage basins are assumed in suburban areas where the basins with adequate buffer zones can be incorporated in the planning of the area, and cost could be minimized. The balance between storage and treatment has been optimized and is shown in Figure B6. The optimum rates of treatment to storage varies from 25 to 40% of the peak flow. The treatment units are designed to be capable of treating 30%

of the peak flow, and the storage basin has capacity to store the remainder of the hydrograph plus two hours detention volume based on the treatment rate of 30% of the peak flow.

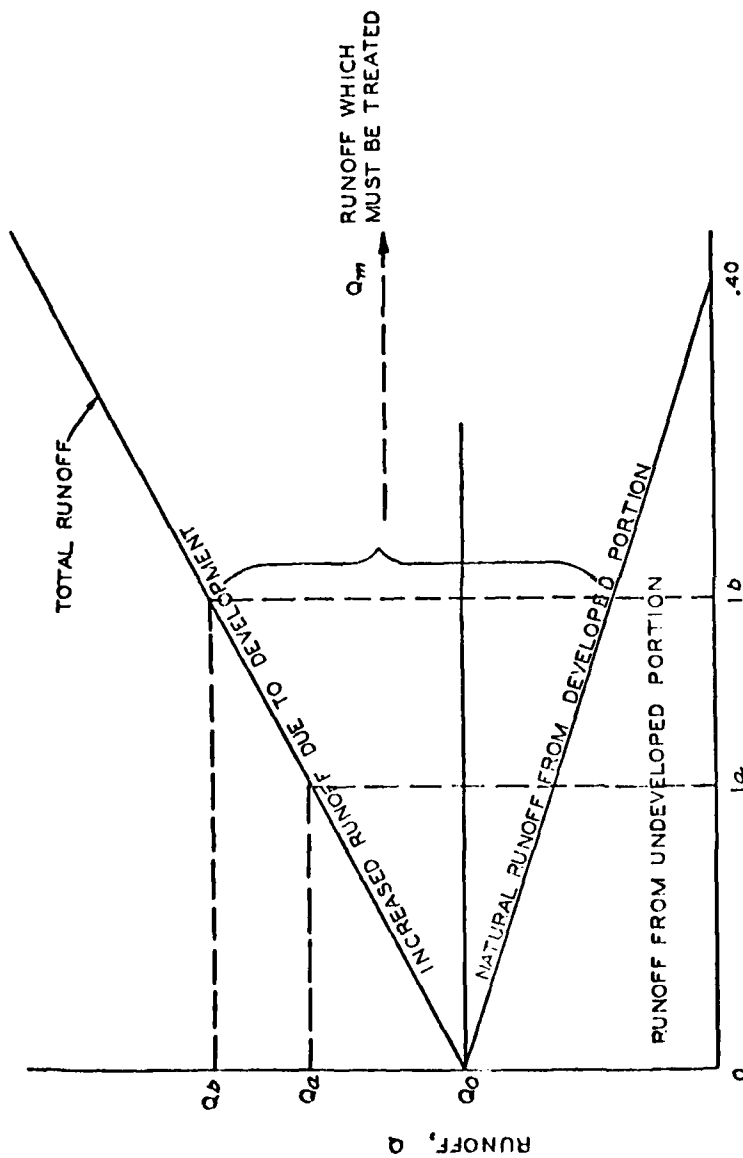
The earth basins would be designed into the developments and utilized as green space or parks. The storage capacity of the basins is equivalent of the one year design storms. The treatment units would have capacity to empty the basin in three days.

The concrete basins would also be used for combined sewage overflows. Sludge in the combined sewer concrete basins is collected and pumped or trucked to a municipal plant for final disposal.

Sludge is collected in the separate concrete and earth basins and taken to a central sludge disposal area.

#### 2.4 STORAGE BASINS WHEN RELEASED TO MUNICIPAL TREATMENT PLANTS

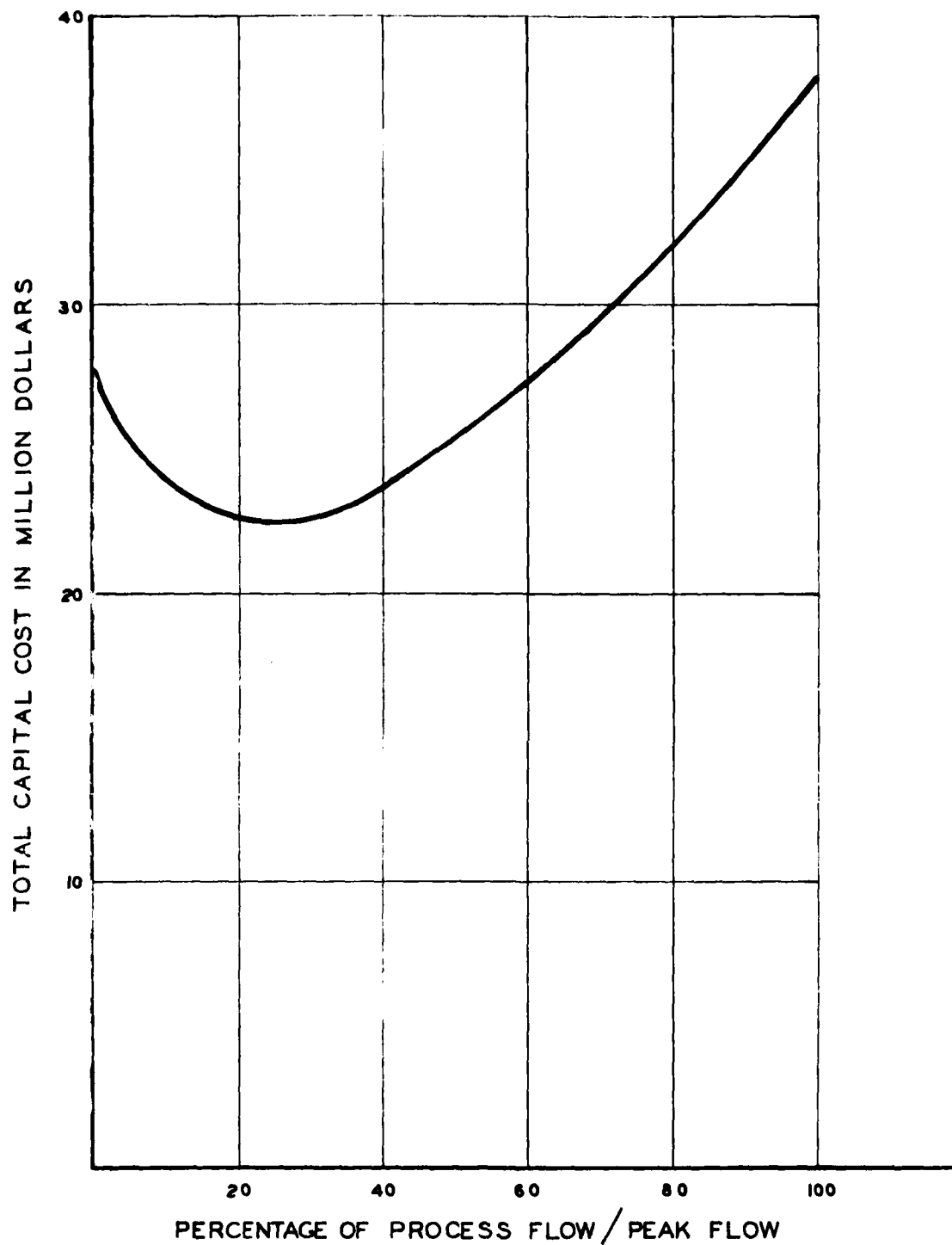
Under the plans where the storm water or combined sewer overflow is stored and released to plants, the volume of storage is equal to 20% of the annual runoff for the earth basins and the 1-year storm volume for concrete basins. In stormwater basins, the pump out capacity is designed to empty the basin in thirty (30) days and in the combined sewer overflow areas the pump out capacity is three (3) days. Both concrete and earth basins are used, with only concrete being used for the combined sewer area. Sludge is not removed in the concrete basins but is collected and pumped with the outfall to the municipal plant. In the earth basins, the sludge would be removed by earth moving machinery on an annual basis.



FRACTION IMPERVIOUS I

$$Q_m = I_b \left[ 2.5Q_b + \frac{Q_b - Q_a}{I_b - I_a} (1 - 2.5 I_b) \right]$$

FIGURE B5  
STORMWATER FLOW  
REDUCTION FORMULA



**FIGURE B 6**  
**COST OPTIMIZATION**  
**STORMWATER TREATMENT**  
**TO LEVEL:1 W/CONCRETE BASIN**

### 3. UNIT COSTS

Table B2 shows a list of various unit capital costs of processes used for treatment of separate stormwater and combined sewer overflows to Level 1 and Level 2. These costs were used in preparation of cost estimates for the alternative plans, and were based on January, 1972 cost with ENR construction index of 1740.

#### 3.1 CAPITAL COST

The reference numbers follow the process being discussed.

TABLE B2

SEPARATE STORMWATER AND COMBINED SEWER OVERFLOWS  
UNIT CAPITAL COST  
FIGURE IDENTIFICATION

Separate Stormwater w/earth Basin - Level 1	B7
Separate Stormwater and Combined Sewer Overflows w/concrete Basin - Level 1	B8
Separate Stormwater w/earth Basin - Level 2	B9
Separate Stormwater w/concrete Basin - Level 2	B10
Combined Sewer Overflows w/concrete Basin - Level 2	B11
Earth Basin	B12
Microstrainers	B13

These processes are briefly discussed below to identify design parameters, the items included in each process, and the cost data reference.

Separate storm with Earth Basin - Level 1, Figure B7 represents the total construction cost of treatment as shown on the schematic diagram of Figure 41, and includes diversion and screening, earth storage and sedimentation basin, pumping, microstrainers, backwash sedimentation and ozonation. Ref. 21,1,4,16,9

Separate storm and combined sewer overflows - Level 1, Figure B8

represents the total construction cost of treatment as shown on the schematic diagram of Figure B2, and includes diversion and screening, concrete storage and sedimentation basin, pumping, microstrainers, backwash sedimentation and ozonation. Ref. 22,1,4,16,9

Separate stormwater w/earth Basin - Level 2, Figure B9 represents the total construction cost of treatment as shown on the schematic diagram of Figure B3, and includes diversion and screening, earth storage and sedimentation with chemicals, pumping, carbon filter and ozonation. Ref. 21,1,14,12,9,11

Separate stormwater w/concrete Basin - Level 2, Figure B10 represents the total construction cost of treatment as shown on Figure B4, and includes diversion and screening, concrete storage and sedimentation with chemicals, pumping, carbon filter and ozonation. Ref. 22,1,14,12,9,11

Combined sewer overflows w/concrete Basin - Level 2, Figure B11 represents the total construction cost of treatment as shown on Figure B4, and includes diversion and screening, concrete storage and sedimentation with chemicals, pumping, breakpoint chlorination, carbon filter and ozonation. Ref. 22,1,14,12,9,11

Earth Basin Figure B12 represents the total construction cost of earth storage basin with depth of 10-15 ft. Ref. 21

Microstrainers Figure B13 represents the total construction cost for microstrainers with a hydraulic loading of 1200-1600 gal./sq.ft./hr. using a Mark 0 (23 micron) screen.

### 3.2 OPERATION AND MAINTENANCE UNIT COSTS

Facilities for stormwater and combined sewer overflows treatment will be intermittently operated to treat flows from rainfall events as they occur. Therefore, cost data, which is available from various references and based on continuous operation, was multiplied by a reduction factor to reflect the intermittent nature of treatment.

Most of the operation and maintenance unit cost data available was based on rate of flow, but since rate of flow is variable during each storm and from one storm to another, it will be logical to base O & M cost on volume of stormwater and combined sewer overflows. To accomplish this, a detailed design was worked out for a typical storm subdistrict and all units of treatment were sized for Level 1 and Level 2 according to the basis of design discussed before. The cost of chemicals required for each process was also included. Ref. 5,1,4,16,12,22

Following is a summary of this cost analysis:

TABLE B3  
OPERATION AND MAINTENANCE UNIT COST

<u>Process</u>	<u>Unit O &amp; M Cost Dollars/Million Gallon</u>
1 - Concrete Storage (Based on 20% of Annual Volume)	68
2 - Earth Storage (Based on 20% of Annual Volume)	33
3 - Level 1: Treatment w/Concrete Basin	62
4 - Level 1: Treatment w/Earth Basin	35
5 - Level 2: Separate Stormwater Treatment w/Earth Basin	250
6 - Level 2: Separate Stormwater Treatment w/Concrete Basin	290
7 - Level 2: Combined Sewer Overflow Treatment w/Concrete Basin	385

The above mentioned operation and maintenance unit costs are further described below:

Concrete Storage: This storage was sized to receive 20% of the total annual runoff and would be used to store stormwater or combined sewer overflows before release for treatment at domestic waste treatment plant. Concrete storage basin will be provided with mechanical sludge

collectors. The operation and maintenance cost includes manpower, materials supply and electric power required for screening, basin with collectors and pumping.

Earth Storage: Capacity was based on 20% of the total annual runoff and would be used to store stormwater before release for treatment at domestic wastewater treatment plant. The operation and maintenance cost includes manpower, materials supply and electric power required for screening, basin and pumping.

Level 1 - Treatment w/Concrete Basins: The capacity of storage-sedimentation basin in this process is designed according to the basis of design in article II-B-3, and this volume is considerably less than the concrete storage mentioned above in Concrete Storage. The operation and maintenance cost includes manpower, materials supply and electric power required for screening, storage and sedimentation with collectors, pumping, microstrainers and disinfection.

Level 1 - Treatment w/Earth Basin: The capacity of storage-sedimentation basin in this process is designed to receive the volume of one-year storm which is less than 20% of annual volume used for earth storage mentioned above in Earth Storage. The operation and maintenance cost includes manpower, materials supply, and electric power required for screening, storage-sedimentation pumping, microstrainers and disinfection.

Level 2 - Separate Stormwater Treatment w/Earth Basin: Storage-sedimentation basin capacity is the same as in Level 1 mentioned above. Chemical cost is substantial and includes: powdered activated carbon: 89 \$/MG, ozone: 50 \$/MG, granular activated carbon (make up) 8 \$/MG a total chemical cost of 188 \$/MG. In addition to chemical cost, the

operation and maintenance cost includes manpower, materials supply and electric power required for screening, flash mixing and flocculation, storage and sedimentation, pumping, activated carbon filter and ozonation.

Level 2 - Separate Stormwater Treatment w/Concrete Basin: This process is similar to the one described in Level 2 above except for concrete storage sedimentation basin with sludge collectors.

Level 2 - Combined Sewer Overflows Treatment w/Concrete Basin: The capacity of storage-sedimentation basin in this process is the same as described in Level 1 - Treatment w/Concrete Basins above, and is provided with mechanical sludge collectors. The chemical cost constitutes a major portion of the operation and maintenance cost. The chemical cost includes: powdered activated carbon: 100 \$/MG, Lime: 3 \$/MG, Alum: 26 \$/MG, polymer: 5 \$/MG, chlorine for solids stabilization: 35 \$/MG, chlorine for breakpoint chlorination: 22 \$/MG, lime for breakpoint chlorination: 5 \$/MG, ozone: 50 \$/MG, granular activated carbon (filter make up) 8 \$/MG, a total chemical cost of 254 \$/MG.

In addition to chemical cost, the operation and maintenance cost includes manpower, materials supply, and electric power required for screening, flash mixing and flocculation, storage and sedimentation, pumping, breakpoint chlorination, activated carbon filter and ozonation.

Breakpoint chlorination O & M cost was based on a chlorine dosage of 8 x ammonia nitrogen concentrators in the influent.

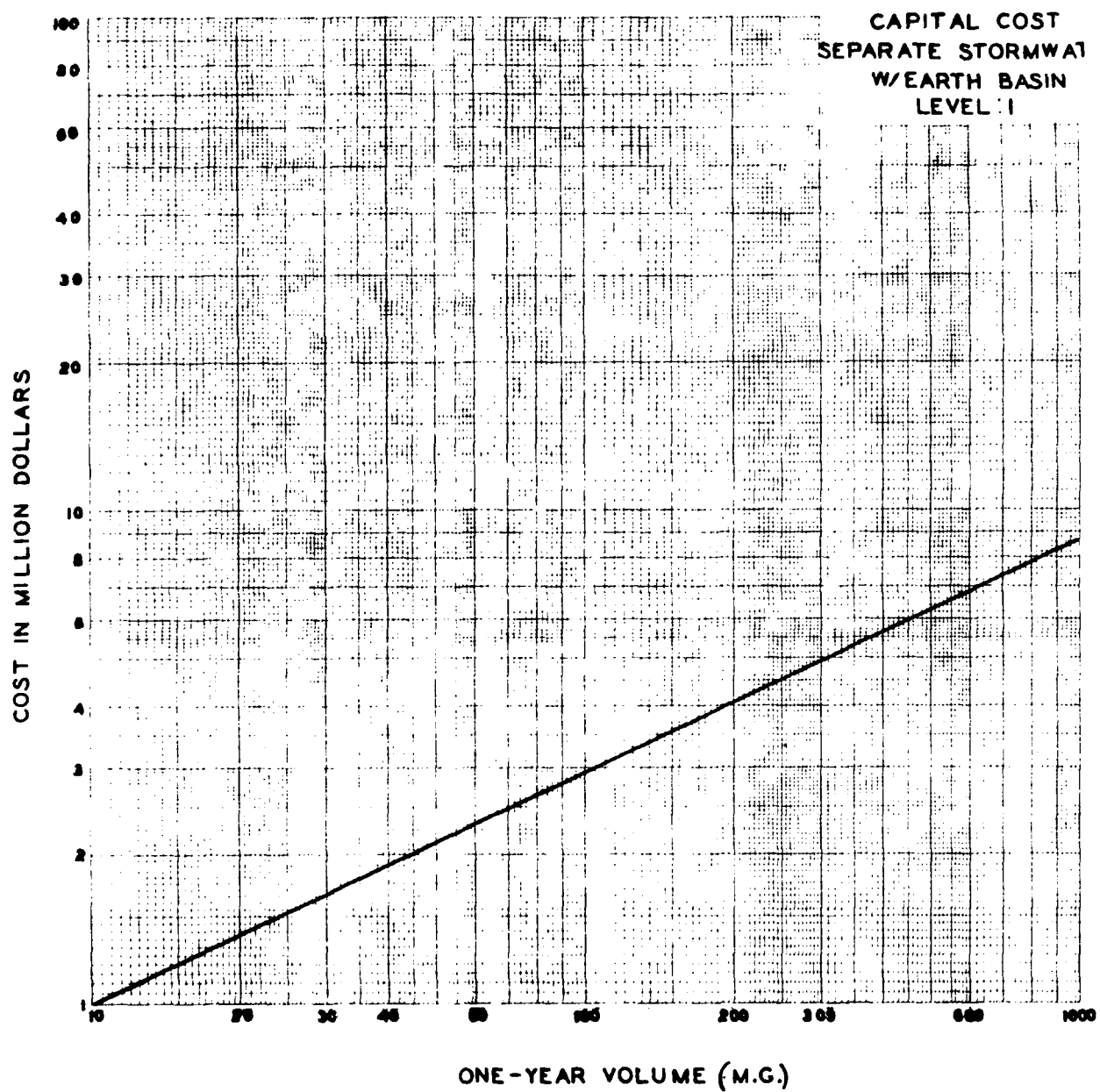


Figure No. B7

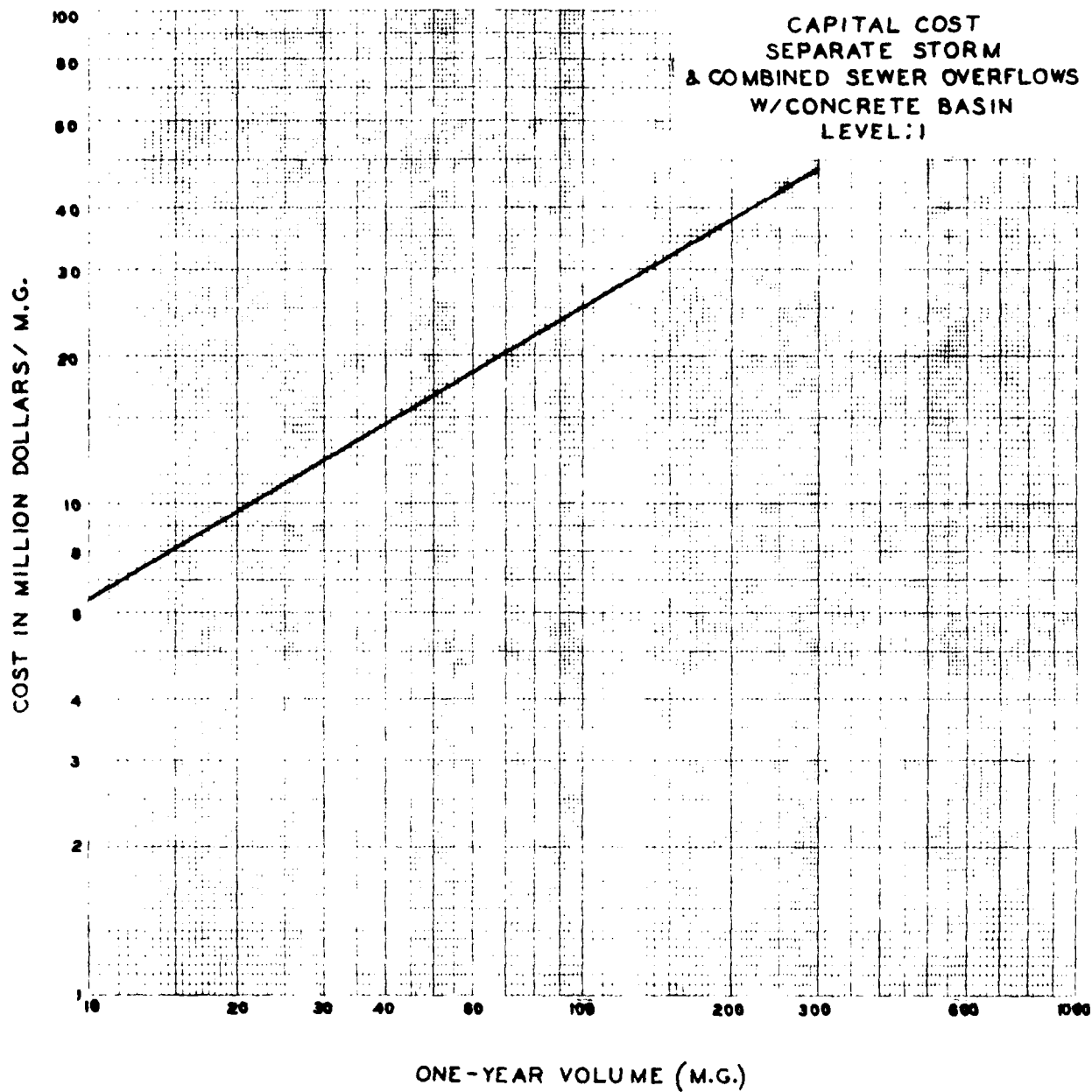


Figure No. B8

B25

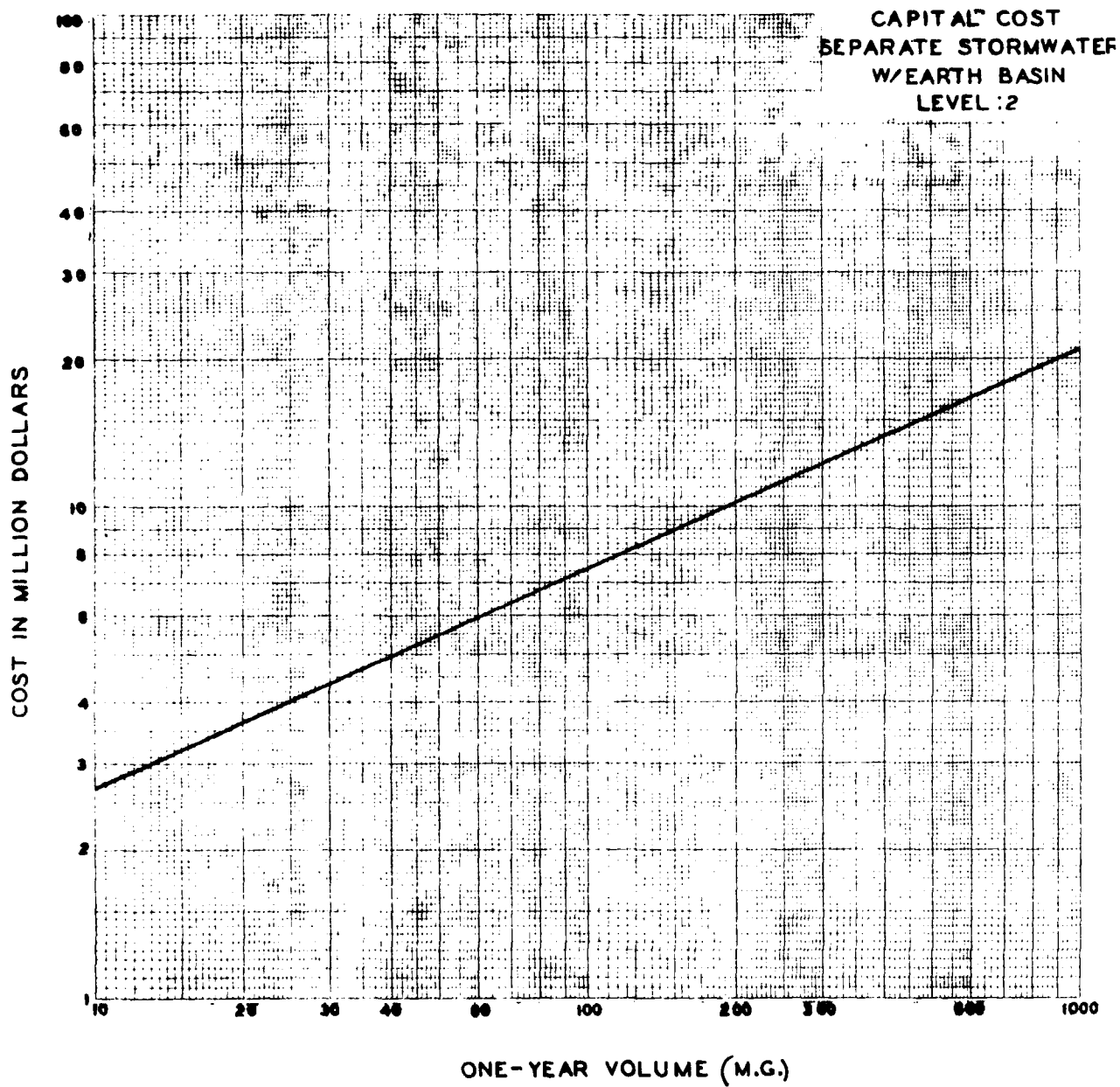


Figure No. B9

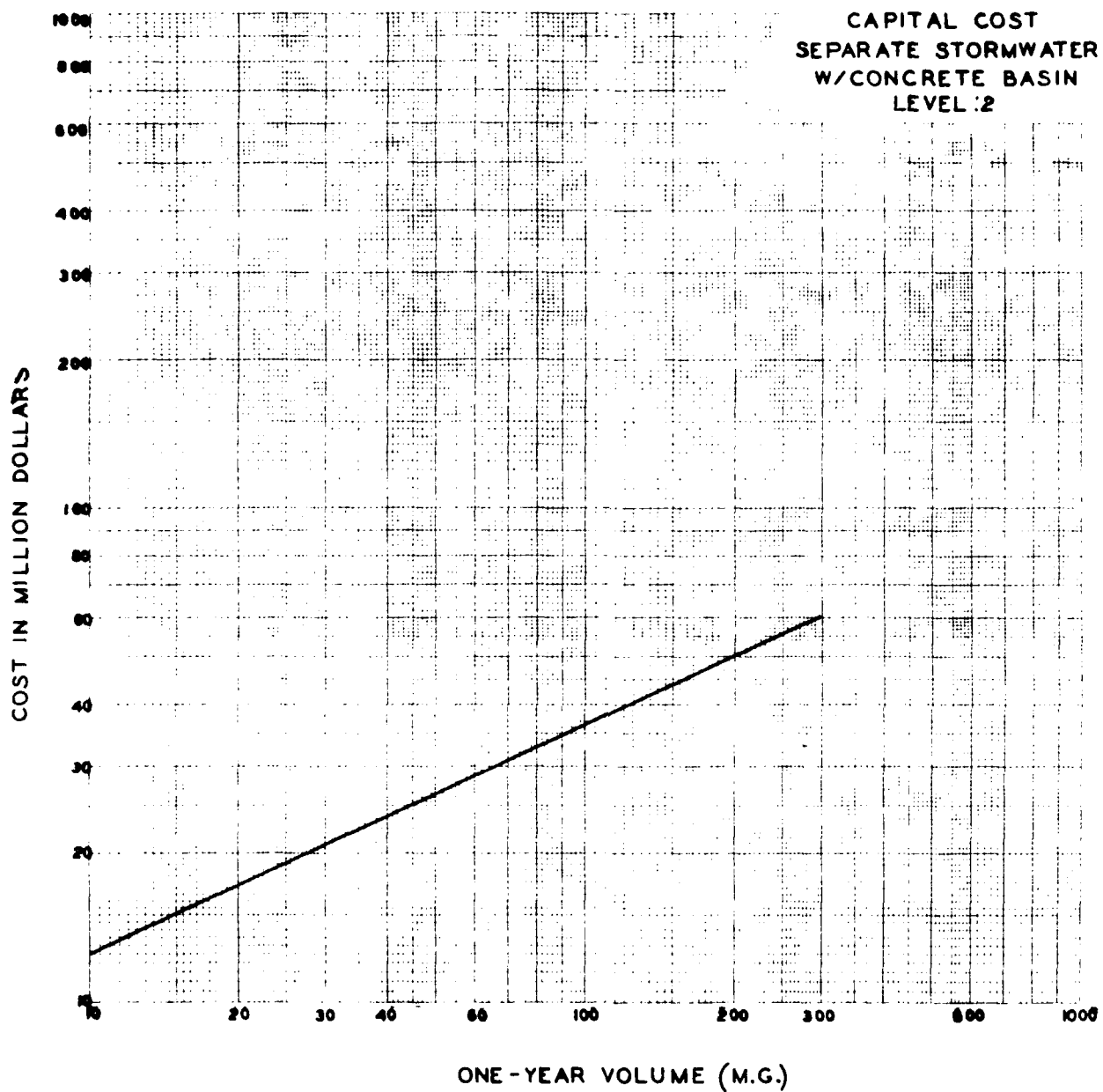


Figure No. B10

CAPITAL COST  
COMBINED SEWER OVERFLOWS  
W/CONCRETE BASIN  
LEVEL 2

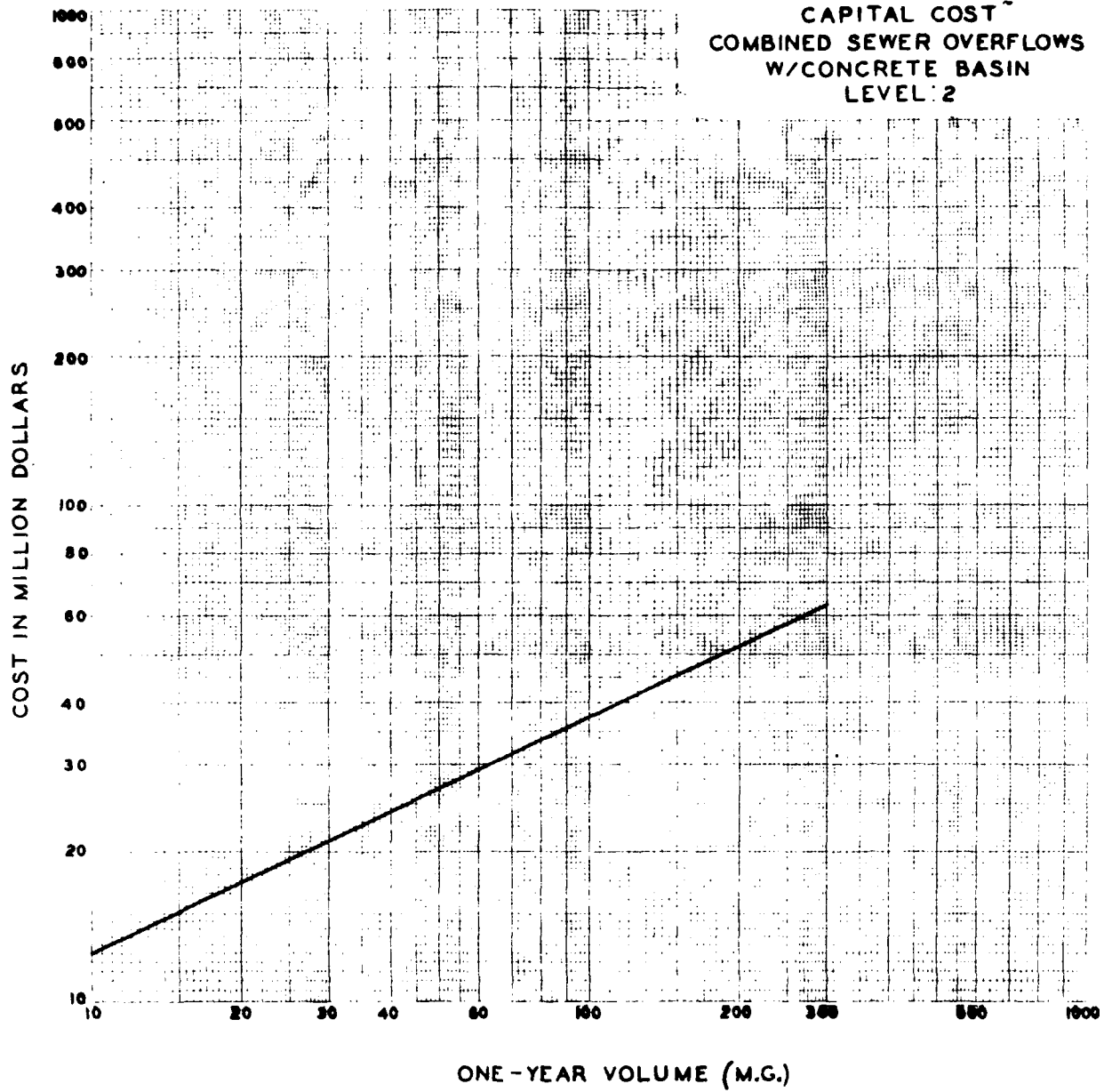


Figure No. B11

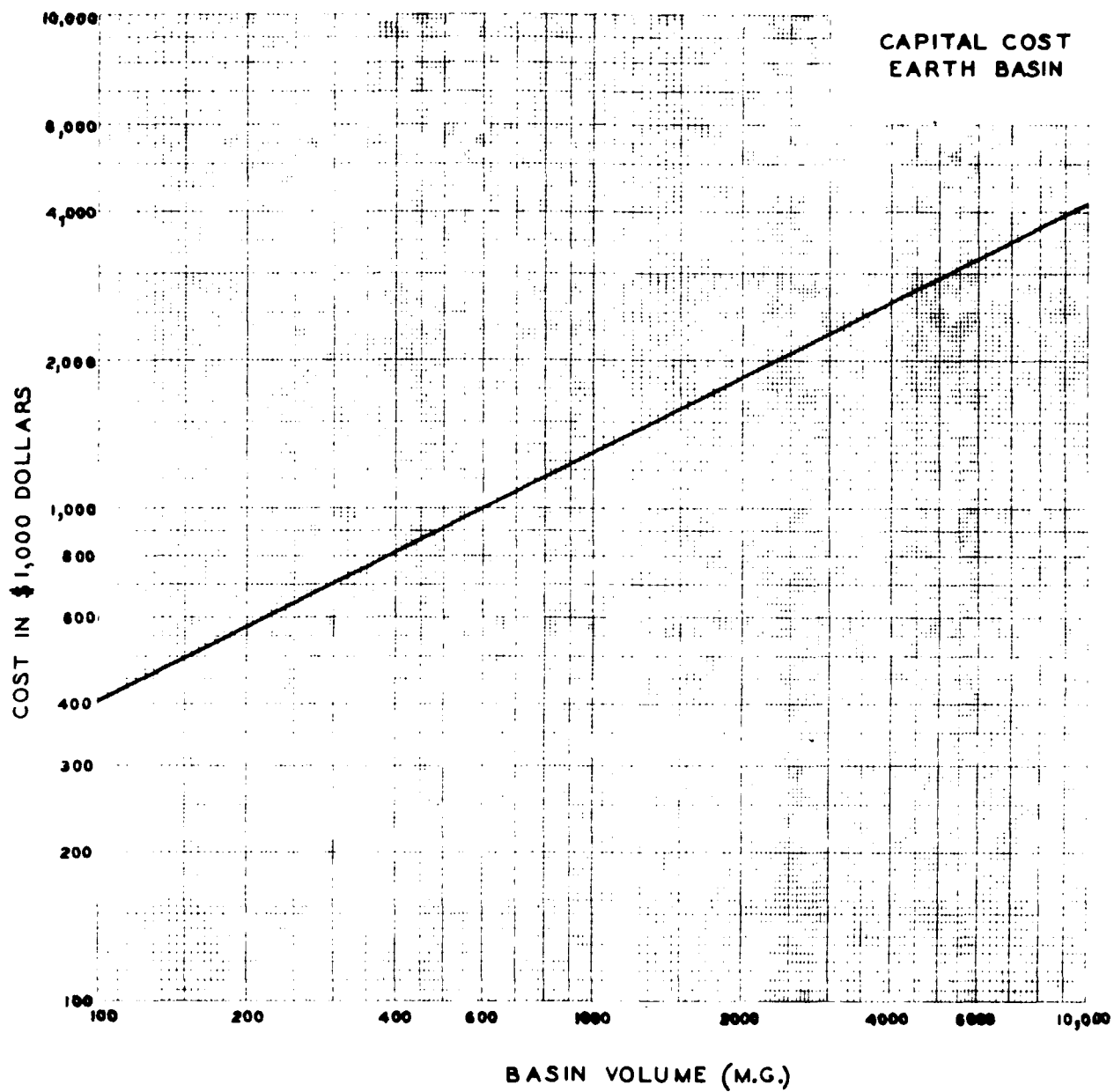


Figure No. B12

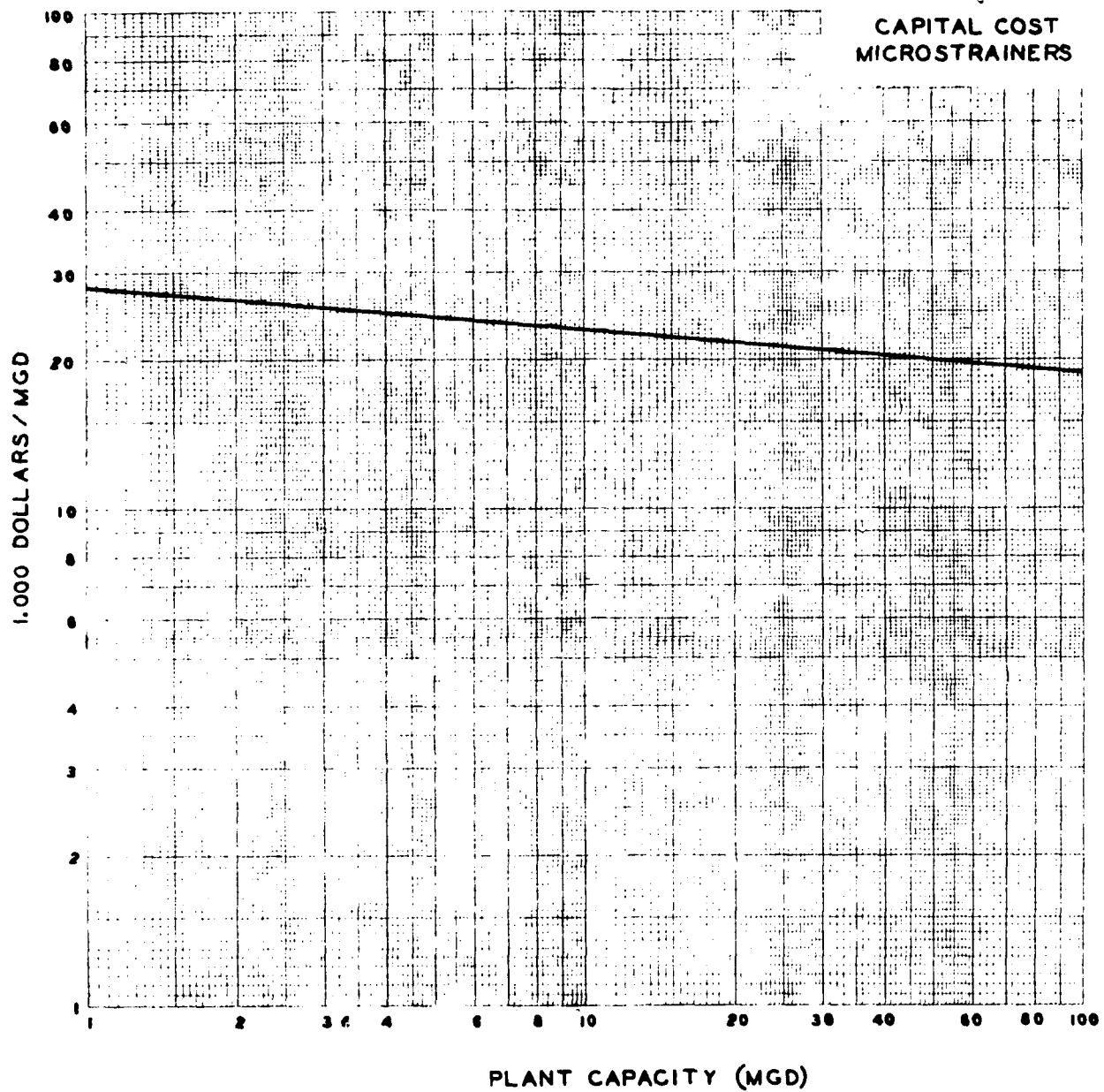


Figure No. B13

#### 4. STORM WATER PLAN FORMULATION ALTERNATIVES

This section presents a discussion of the alternatives considered for storm water treatment in formulation of the wastewater management plans.

##### 4.1 Design Storm Alternative

A study of the hydrology of the study area, and of the runoff generated by storms of various intensities and frequencies was made in the Phase I portion of the Survey Scope Studies. As a result of these investigations, the 1-year storm was recommended as the design storm for the runoff collection and treatment system. For details of this subject, the reader is referred to the Phase I report, but a discussion of this matter is presented here for amplification and for comparison with the plans prepared in the Chicago area studies.

As established in the Phase I hydrologic studies, the 1-year design storm yields runoff at a peak rate of approximately 0.5 cfs per acre, which is the critical design value used to size elements of the collection system. This is the same runoff rate used in design of the collection system in the Chicago area studies. For storms of greater intensity, storm water runoff would be stored on the surface, in street gutters and in natural depressions and would eventually be conveyed to the storage and treatment facilities.

In the present Cleveland-Akron studies, two general plans of storm water treatment are used, depending on relative economy and local conditions. Where storm water is to be stored and treated in the municipal wastewater treatment plants, storage facilities

were designed to contain 20% of the total annual volume of runoff. This storage volume is equivalent to the volume necessary to contain runoff from the 100-year storm, and amounts to 1.26 inches of runoff over the gross area.

Where storm water is stored and treated at separate storm water treatment plants, the storage facilities were designed to contain the 1-year storm, equivalent to approximately 0.4 inches of runoff. Flows in excess of this volume would undergo screening, sedimentation and disinfection, so that no storm water flows would be discharged without some treatment. All flows up to the design 1-year storm would receive complete Level 1 and Level 2 treatment as called for by the particular alternative plan. In comparing these criteria to the preliminary design of the Chicago area system, several important differences in characteristics of the study area should be noted. Due to the intense urbanization in Chicago, a higher runoff factor was used, which results in a greater quantity of runoff from a given storm. As shown in Table B4a, the runoff from a 1-year storm in Chicago is approximately 1.0 inch whereas, in the Cleveland study area, the total runoff from a storm of the same frequency is 0.4 inches. For the 100-year storm, runoff in the Chicago area, is 2.5 inches compared with 1.26 inches in Cleveland.

Since the runoff intensity rate of 0.5 cfs per acre was used in both cases, and in both cases facilities for storage and treatment with municipal wastewater can accept runoff from the 100-year storm, the two systems are exactly comparable in this regard. It is

only in those instances in the Cleveland plan where storm water storage and treatment is handled separately from municipal treatment plants that the Cleveland design is based on retention and treatment of 0.4 inches, equivalent to the 1-year storm criteria. These figures are shown on Table B4a.

TABLE B4a  
STORMWATER COLLECTION AND TREATMENT  
IN CLEVELAND-AKRON AREA  
COMPARED TO CHICAGO AREA

<u>RAINFALL-RUNOFF</u>	<u>CHICAGO</u>	<u>CLEVELAND</u>
1-year storm rainfall	1.80 inches	1.14 inches
1-year storm runoff	1.0 inches	0.4 inches
100 year storm rainfall	4.40 inches	3.60 inches
100 year storm runoff	2.5 inches	1.26 inches
Design discharge for pipes	0.5 cfs/acre	0.5 cfs/acre
Storage and Treatment with municipal wastewater	2.50 inches	1.26 inches
Storage and Treatment at separate stormwater plants	No comparable plan	0.40 inches

To further discuss this question, cost estimates were prepared for a collection system adequate to convey the 1, 10, and 100-year storm runoffs. Using the 1-year collection system cost as a base of 1, the cost ratio of the 10-year collection system would be 1.65, and of the 100-year systems would be 3.3. Expressed as a percentage of the total storm water collection and treatment cost, these values are respectively 32%, 43% and 60%.

The percentage of the total runoff treated under the different alternates for the 1-year and 100-year storms were computed and

compared to the Chicago plan. In addition, the estimated pollutant loads generated and the residual pollutant loads discharged to the receiving waters were calculated for comparison of the approximate overall benefit to be derived from the additional expenditures necessary.

Table B4b shows the total BOD and SS loads generated in the study area, together with the residual loads discharged to the receiving waters for a year including a 1-year storm occurrence compared with loads discharged for a year including a 100-year storm occurrence. The residual loads are calculated for the 100-year storm design and for the 1-year storm design, both to Level 2 treatment.

The table shows the reduction in residual loads in going from the 1-year to the 100-year design to be 0.83 percent of the total BOD load generated and 6.2 percent of the total SS load generated. These percentages are for a year including a 100-year storm occurrence.

For an average year, the percentage reductions would be even less. This appears to be a minimal improvement for an increased expenditure of 60%.

Finally, Table B4c shows a comparison between the Chicago and Cleveland-Akron designs in terms of residual loads discharged from the combined and urban stormwater discharges only. (Not including municipal sewage effluents). Although this comparison is only approximate because of differences in the study area, the table shows that the residual loads discharged in the two cases are closely comparable.

TABLE B4b

CLEVELAND AREA RESIDUAL ANNUAL STORMWATER RUNOFF LOADS  
INCLUDING A 1 AND 100 YEAR STORM OCCURRENCE

	Municipal		Combined Overflow		Separate Stormwater		Total	
	1 Year	100 Year	1 Year	100 Year	1 Year	100 Year	1 Year	100 Year
2020 Flow mg/year (percent of total)	295,810 (78)	295,810 (75)	16,150 (4)	19,200 (5)	65,600 (18)	79,600 (20)	377,560 (100)	394,610 (100)
BOD Total 1000#/year (percent of total)	435,000 (96)	435,000 (95)	8,070 (2)	9,600 (2)	11,100 (2)	13,400 (3)	454,170 (100)	458,000 (100)
Suspended Solids, Total, 1000#/year (percent of total)	441,000 (68)	441,000 (63)	26,900 (4)	32,000 (5)	183,800 (28)	223,000 (32)	651,700 (100)	696,000 (100)
Residual BOD 1000 #/year with Level 2 treatment 100 year storm design (percent of total)	860 (82)	860 (79)	80 (8)	96 (9)	111 (10)	134 (12)	1,051 (100)	1,090 (100)
Residual SS (as above) (percent of total)	879 (45)	879 (41)	135 (7)	160 (7)	920 (48)	1,115 (52)	1,934	2,154
Residual BOD 1000#/year with Level 2 treatment 1 year storm design (percent of total)	860 (82)	860 (18)	80 (8)	1,610 (33)	111 (10)	2,411 (49)	1,051 (100)	4,881 (100)
Residual SS (as above) (percent of total)	879 (45)	879 (2)	135 (7)	5,100 (11)	920 (48)	39,200 (87)	1,934 (100)	45,179 (100)

After consideration of these and other factors, the previously established storm design criteria is confirmed, and is used in the Phase II and III studies.

TABLE B4c

COMPARISON OF RESIDUAL ANNUAL STORMWATER RUNOFF LOADS  
INCLUDING A 1 AND 100 YEAR STORM OCCURRENCE

	CLEVELAND				CHICAGO Equivalent Area (1)	
	Combined Overflows		Separate Stormwater		Total	
	1 Year	100 Years	1 Year	100 Years	1 Year	100 Years
Flow mg/year	16,150	19,200	65,600	79,600	81,750	98,800
BOD Total 1000 #/year	8,070	9,600	11,100	13,400	19,170	24,000
S.S. Total 1000 #/year	26,900	32,000	183,800	223,000	210,700	255,000
Residual BOD 1000 #/year Level 2 Treatment 100 year storm design	80	96	111	134	191	230
Residual SS (as above)	135	160	920	1,113	1,055	1,275
					1,880	2,910
					375,000	582,000

(1) For comparison, this data has been computed for an area of Chicago equal to the study area in the Cleveland-Akron Three Rivers Plan.

TABLE B5

COST OF INCREASED PROTECTION AND TREATMENT

100 Year Compared To 1 Year Runoff

		Ratio of Capital Cost	
		<u>Level 1</u>	<u>Level 2</u>
Alternative of Treatment with municipal wastewater*	Earth Basin	1.08	1.06
	Concrete Basin	1.67	1.66
Alternative of separate treatment	Earth Basin	2.56	2.52
	Concrete Basin	4.37	3.14

\*low ratio results because with this scheme the storage capacity is 20% of the annual volume which is approximately equal to the 100 year storm. This capacity of storage is required in order to release low flows that can be conveyed in existing sewers and not overload the wastewater treatment plant.

#### 4.2 STORAGE ALTERNATIVES

The construction of concrete storage basins is more expensive than constructing earth basins. Concrete basins have the advantages of being covered to prevent accidents, control odors, make sludge collection simpler and uses less land. The earth basins have the advantages of being less costly, providing additional green space, and could be developed into recreational areas.

For plans 1 and 2, the storm water runoff plans were formulated in two ways - one: all concrete basins; second, a combination of concrete basins and earth basins. With the combination plan, concrete basins were considered for all dense urban sites or areas that were already developed with storm and sanitary sewers when infiltration or illegal cross-connections were a problem. All combined sewer areas were supplied with concrete basins. The cost comparisons for these plans are shown in Table B6 and reflect cost for the unadjusted flows as described in 4.3. For a cost comparison, the plan was computed for a situation having all earth basins. This, of course, would not be recommended in combined sewer areas and is presented for cost information only.

TABLE B6  
CONCRETE STORAGE COST

	<u>2020 Volume (MG/YEAR)</u>	<u>Plant Capital (\$1000)</u>	<u>Plant O&amp;M (\$1000/Yr)</u>	<u>Pipe Capital (\$1000)</u>	<u>Pipe O&amp;M (\$1000/Yr)</u>	<u>Annual Compar. Value (\$1000/Yr)</u>
Plan #1 Concrete & Earth	86,693	784,540	4,309	348,646	2,179	92,330
Plan #1 All Concrete	86,693	1,752,900	5,377	348,646	2,179	160,395
Plan #1 All Earth	86,693	440,000	4,400	348,646	2,179	71,079

#### 4.3 SENSITIVITY OF FLOW ADJUSTMENT ASSUMPTION

As discussed in Section 2.2, the peak flow and volume were adjusted for the institutional constraint of zoning. In order to show the potential benefit of the type of zoning, plans 1 and 2 were computed using the unadjusted flow rates and volumes. The results are shown in Table B7.

TABLE B7  
UNADJUSTED VS. ADJUSTED FLOW COSTS

	<u>2020 Volume (MG/Year)</u>	<u>Plant Capital (\$1000)</u>	<u>Plant O&amp;M (\$1000/Yr)</u>	<u>Pipe Capital (\$1000)</u>	<u>Pipe O &amp; M (\$1000/Yr)</u>	<u>Annual Compar. Value (\$1000/Yr)</u>
Plan #1 & #2 Unadjusted Flow	86,693	784,540	4,309	348,646	2,179	92,330
Plan #1 & #2 Adjusted Flow	74,254	747,886	3,718	345,824	2,156	88,683

#### 4.4 COMPARISON OF LEVEL 1 AND LEVEL 2 LOADS TO RURAL RUNOFF

BOD and suspended solids loads from the urban area, both combined and separate, and the rural loads are compared to evaluate the significance of each source and reduction possible by treatment of the urban runoff. Comparing the rural load contribution to the urban load shows that 6.6% of the BOD and 28.3% of the suspended solid originates from the rural area.

Table B8 illustrates the net effect on stormwater BOD and suspended solids residuals as compared to the total stormwater runoff for the study area. Increasing the degree of treatment from Level 1 to Level 2 increases the BOD percent removal from 68 to 91 and the suspended solid percent removal from 63 to 71.

This is discussed further in Section 4.6 with respect to the total load from the study area.

TABLE B8  
EFFECT OF TREATMENT ON STORMWATER  
RUNOFF

	<u>1970</u>		<u>2020</u>	
	<u>MG/Yr.</u>	<u>%</u>	<u>MG/Yr.</u>	<u>%</u>
<u>VOLUMES</u>				
Urban (Combined) Runoff	14,506	12	16,150	12
Urban (Separate) Runoff	20,949	19	65,561	51
Rural Runoff	78,668	69	49,515	37
Total Runoff	114,123	100	131,226	100

		<u>2020</u>	<u>1000 lbs.</u>	<u>1000 lbs.</u>	<u>Percent of Total</u>	
		<u>1000 lbs./Yr.</u>	<u>Removed</u>	<u>Residual</u>	<u>Removed</u>	<u>Residual</u>
<u>BOD</u>						
Level 1	(Urban (Combined)	8,070	6,690	1,380	32	8
	(Urban (Separate)	11,099	7,390	3,709	36	18
	(Rural	1,341	0	1,341	0	6
	(Total	20,510	14,080	6,430	68	32
Level 2	(Urban (Combined)	8,070	7,908	162	38	0.8
	(Urban (Separate)	11,099	10,766	333	53	1.6
	(Rural	1,341	0	1,341	0	6.6
	(Total	20,510	18,674	1,836	91	9

		<u>2020</u>	<u>1000 lbs.</u>	<u>1000 lbs.</u>	<u>Percent of Total</u>	
		<u>1000 lbs./Yr.</u>	<u>Removed</u>	<u>Residual</u>	<u>Removed</u>	<u>Residual</u>
<u>SUSPENDED SOLIDS</u>						
Level 1	(Urban (Combined)	26,908	22,871	4,037	7	2
	(Urban (Separate)	183,812	165,430	18,382	56	6
	(Rural	84,680	0	84,680	0	29
	(Total	295,400	188,302	107,099	63	37
Level 2	(Urban (Combined)	26,908	26,638	270	9	.1
	(Urban (Separate)	183,812	181,973	1,839	62	.6
	(Rural	84,680	0	84,680	0	28.3
	(Total	295,400	208,611	86,789	71	29

#### 4.5 COST OF TREATING NON-SEPARABLE COMBINED SEWER OVERFLOWS

The plans 1 through 12 present cost data for runoff which does in fact include all runoff resulting from rainfall. These costs are not totally additive to municipal wastewater treatment cost since a part of this runoff is in combined sewer areas when the flows are mixed and the storm water is treated regardless of the scheme. In order to present the appropriate wastewater management cost, the combined sewer area cost has been separated from the total stormwater runoff cost. The flow from the combined sewer areas would be the first to receive treatment.

Table B9 shows the separation. Flows from each area are indicated and the total capital cost of constructing collection, storage, and treatment facilities are shown.

TABLE B9  
COMBINED OVERFLOW COST

Plan	Level	Combined Overflow MG/Yr.	Separate Stormwater MG/Yr.	Total Capital Cost	
				Combined \$1,000,000	Separate \$1,000,000
1	1	16,218	58,036	348	744
2	1	16,218	58,036	348	744
3	2	16,218	58,036	812	1,734
4	2	16,218	58,036	537	1,380
5	1	16,218	58,036	750	801
6	1	16,218	58,036	731	798
7	2	16,218	58,036	338	1,339
8	2	16,218	58,036	369	1,286
9A	2	16,218	58,036	555	1,791
10	2	16,218	58,036	812	1,734
11	2	16,218	58,036	768	1,709
12	2	16,218	58,036	388	1,049

#### 4.6 COST OF INCREASED TREATMENT

The total annual cost of increasing treatment to meet the level 2 goals over level 1 is compared with the increase in pollutant residual mass loads. This data reflects the incremental removal using plan 1 which was designed both for level 1 and 2 goals.

TABLE B10  
STORM WATER REMOVAL

<u>Parameter</u>	<u>Total Removal of Level 1</u>	<u>Level 2</u>	<u>Incremental Removal of Level 2</u>	<u>Incremental Removal Cost of Level 2</u>
Suspended Solids	84%	99%	15%	100%
BOD <sub>5</sub>	65%	97%	32%	
Nitrogen, (Total)	54%	95%	41%	
Phosphorus	77%	94%	17%	

TABLE B11  
MUNICIPAL WASTE

<u>Parameter</u>	<u>Total Removal of Level 1</u>	<u>Level 2</u>	<u>Incremental Removal of Level 2</u>	<u>Incremental Removal Cost of Level 2</u>
Suspended Solids	99%	99%	0%	43%
BOD <sub>5</sub>	97%	99%	2%	
Nitrogen, (Total)	26%	97%	71%	
Phosphorus	96%	99%	3%	
COD	93%	98%	5%	

Table B12 shows the residual loads resulting from the two levels expressed in pounds per year and also as a percent of the total load. The rural loads are not treated. The urban load is the total from both the separate and combined sewer areas.

TABLE B12

RESIDUAL LOADS\* 1,000 lbs/year

Parameters	Urban Runoff		Rural Runoff		Municipal		Total	
	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2
Suspended Solids	22,419	2,109	84,680	84,680	4,838	879	111,937	87,668
BOD <sub>5</sub>	5,089	495	1,341	1,341	12,046	860	18,476	2,696
Nitrogen, Total	1,496	163	825	825	41,901	1,689	44,222	2,677
Phosphorus	343	81	83	83	1,207	241	1,633	405

RESIDUAL LOADS, percent of total

Suspended Solids	20	3	76	96	4	1	100	100
BOD <sub>5</sub>	28	18	7	50	65	32	100	100
Nitrogen, Total	3	6	2	31	95	63	100	100
Phosphorus	21	20	5	20	74	60	100	100

\*Total load discharged to receiving waters.

The incremental cost of treating storm water to Level 2 is primarily in the unit process concepts designed for soluble pollutant removal (i.e., organics, nitrogen and phosphorus), with additional suspended solids capture. Nitrogen in the storm and combined sewer runoff is an insignificant percentage of the total when compared to the municipal residual in both Level 1 and 2. The BOD residual, as shown in Table B12, is 36% of the total load when compared to Rural and Municipal, and the suspended solids is 20% of the total load. The suspended solids, although they are 20% of the load, would contain a high percentage of inert materials such as silt. Level 2 treatment reduces the BOD to 18% and Suspended Solids to 3% of the total load.

Comparing the residuals, it would appear that the benefit of treating storm water to Level 2 does not justify the incremental cost.

With municipal wastes, the incremental cost is primarily due to the unit process techniques required for nitrogen and COD removal. Nearly the total load of nitrogen is in the municipal waste and is reduced by 94% by the Level 2 treatment process over Level 1. If the removal of nitrogen can be scientifically shown to reduce the eutrophication of Lake Erie, then its removal should be considered. The incremental cost of Level 2 can be decreased by about 20%, if the COD requirement is reduced. The additional COD removed for this 20 percent cost increment is largely refractory or biologically inert. Thus, its immediate influence on the environment would be minimal whereas its long term affect is unknown. The necessity for this removal and the associated unit process should be weighed against, what are now, immeasurable future benefits.

## C. ALTERNATIVE PLANS - COST ESTIMATES

### 1. - PROCEDURE

Twelve alternative plans have been developed for total wastewater management of the study area. These plans are described in detail by the Plan Formulators, Wright-McLaughlin Engineers, in their phase report and will not be duplicated here.

This section of the report presents the cost estimations of the twelve plans as related to our portion of the study. This portion is described in the following paragraphs. Plans 1 through 8 were computed to both Levels 1 and 2 in order to better evaluate the merits of the plans.

The procedure for the cost estimation include the calculation of the following items for each of the major segments involved.

- 1) Net capital cost - This cost is based on the 2020 design flows and takes into account the present worth of the existing structures.
- 2) Annual Capital - This cost is based on a capital recovery factor multiplied by the net capital cost. The capital recovery factor is a function of the useful life of the item and an interest rate of
- 3) Operation and Maintenance - This cost is based on the 2020 design flow of the particular segment.

### 2. - COMPARATIVE COST PRESENTATION

Havens and Emerson's portion of the alternative plans cost estimation is divided into four basic areas to better evaluate the relative features and costs of each plan. These areas include:

- 1) Wastewater Treatment Plants - Liquid Phase. Table C1 includes the cost breakdown for each plan as previously described for the liquid phase of the wastewater treatment plants and the pipe costs for the required interceptor systems. Of particular importance in the examination

of this table is that the cost fluctuations between plans is dependent upon the quantity of wastewater receiving secondary treatment and the quantity of wastewater receiving advanced treatment.

- 2) Wastewater Treatment Plants - Solid Phase. Table C2 includes the cost breakdown for each plan for the solid phase of the wastewater treatment plant. There are two important variations which explain the cost fluctuation between the plans. The first is that each plan has different combinations of the three techniques utilized for ultimate sludge disposal (incineration, agricultural application, strip mine reclamation). The second is that different quantities of sludge are being generated in each plan due to the differences in the levels of treatment.
- 3) Storm Water Treatment - Liquid Phase. Table C3 includes the cost breakdown for each plan for the liquid phase of stormwater treatment. There are four basic schemes of stormwater treatment which should be noted in the evaluation due to their significant effect on the cost fluctuations of the plans. The difference is largely due to the variation in volumes of storage required for each of these schemes. Scheme 1 requires storage of slightly less than the 1 year storm. Scheme 2 and 3 require storage of the 1 year storm. Scheme 4 requires storage of 20% of the annual runoff, which is the equivalent of the runoff resulting from a 100 year rainfall. Table C5 shows the actual storage volumes required for each plan. Following is a list of the four schemes:
  1. Separate storm water treatment (Levels 1 and 2) with discharge to stream.
  2. Storm water storage and treatment with discharge to land treatment.
  3. Storm water storage only with discharge to land treatment. This was done for Plan 12 only.

4. Storm water storage with discharge to the sanitary system for treatment at the municipal plant.

- 4) Storm Water Treatment - Solid Phase Table C4 includes the cost breakdown for the solid phase of stormwater treatment. The quantity of sludge generated appears to be the most significant variable in causing cost fluctuations between the plans. This varies depending upon the method of stormwater treatment.

WASTEWATER MANAGEMENT PROGRAM  
TABLE C1  
WASTEWATER TREATMENT PLANT - LIQUID PHASE

Plan	Level	Secondary Plants		Advanced Plants		Present	Net	Plant	Total		Sewer	Sewer	Annual	Annual
		md	Capd (\$1000)	md	Capd (\$1000)	Worth (\$1000)	Capital (\$1000)	Annual Cost (\$1000/Yr.)	O & M (\$1000/Yr.)	O & M (\$1000/Yr.)	Capital (\$1000)	O & M (\$1000/Yr.)	Capital Cost (\$1000/Yr.)	Compar. Value (\$1000/Yr.)
1	1	-	-	794	404,236	156,066	248,170	19,159	43,507	59,628	69,310	440	5,024	68,130
1	2	-	-	794	595,586	156,066	439,520	33,930	59,628	69,310	5,024	440	5,024	99,022
2	1	794	368,967	-	-	169,566	197,401	15,239	23,014	65,099	4,720	359	4,720	43,332
2	2	794	368,967	-	-	169,566	197,401	15,239	23,014	65,099	4,720	359	4,720	43,332
3	1	-	-	794	418,610	167,825	250,785	19,360	46,481	75,039	5,440	436	5,440	71,717
3	2	-	-	794	625,898	167,825	458,073	35,400	62,615	75,039	5,440	436	5,440	103,891
4	1	794	370,701	-	-	169,566	201,135	15,528	23,082	65,099	4,720	372	4,720	43,702
4	2	794	370,701	-	-	169,566	201,135	15,528	23,082	65,099	4,720	372	4,720	43,702
5	1	26	24,007	768	395,224	170,066	249,165	19,236	45,395	67,507	4,894	422	4,894	69,947
5	2	26	24,007	768	565,587	170,066	419,628	32,395	65,590	67,507	4,894	422	4,894	103,301
6	1	393	196,409	401	195,792	173,931	218,270	16,850	34,144	67,507	4,894	422	4,894	56,310
6	2	393	196,409	401	310,065	173,931	332,543	25,672	42,092	67,507	4,894	422	4,894	73,080
7	1	26	23,617	768	402,743	162,933	263,427	20,336	49,142	74,218	5,381	463	5,381	75,322
7	2	26	23,617	768	564,027	162,933	424,711	32,788	58,392	74,218	5,381	463	5,381	97,024
8	1	600	283,276	194	96,100	169,541	209,835	16,199	29,136	65,779	4,769	373	4,769	50,477
8	2	600	283,276	194	146,080	169,541	259,815	20,058	34,269	65,779	4,769	373	4,769	59,469
9A	2	328	1,420	466	332,500	92,695	241,225	18,623	33,831	82,754	6,000	548	6,000	59,002
10	2	-	-	794	625,898	167,825	458,073	35,363	62,615	75,046	5,440	436	5,440	103,854
11	2	-	-	794	389,124	-	389,124	33,386	76,503	74,969	5,435	436	5,435	115,760
12	2	794	4,478	-	-	-	4,478	346	1,248	65,099	4,720	406	4,720	6,720

WASTEWATER MANAGEMENT PROGRAM  
TABLE C2  
WASTEWATER TREATMENT PLANT - SOLID PHASE

Plan	Level	Sludge Volumes		Capital Cost				Operation and Maintenance				Annual Compt. Value (\$1000/Yr.)	
		Inciner- ation	Strip Mines	Agricul- tural App- lication	Strip Mines	Pump Station & Force Main	Total	Annual Capital Cost (\$1000/Yr.)	Capital Fac. (\$1000/Yr.)	Pump Station & Force Main (\$1000/Yr.)	Ash Disposal (\$1000/Yr.)		
1	1	835	-	64,360	-	-	64,360	4,969	9,438	-	405	14,811	
1	2	926	-	68,134	-	-	68,134	5,260	10,152	-	667	16,079	
2	1	-	34	477	6,572	40,758	7,924	55,254	4,266	1,499	470	6,235	
2	2	-	34	477	6,572	40,758	7,924	55,254	4,266	1,499	470	6,235	
3	1	464	78	299	10,852	25,180	2,359	68,291	5,272	6,038	142	357	11,809
3	2	515	86	330	11,670	26,710	2,359	72,439	5,590	6,533	142	393	12,658
4	1	-	34	477	6,572	40,758	7,924	55,254	4,266	1,499	470	-	6,235
4	2	-	34	477	6,572	40,758	7,294	55,254	4,266	1,499	470	-	6,235
5	1	376	31	424	5,205	33,500	2,408	76,788	5,928	5,718	145	289	12,080
5	2	413	31	466	5,355	38,050	2,408	83,313	6,431	6,110	145	316	13,002
6	1	247	41	393	7,705	30,858	3,307	60,120	4,641	4,261	184	187	9,273
6	2	272	41	410	7,705	36,590	3,307	66,852	5,160	4,577	184	206	10,127
7	1	372	13	440	3,325	36,000	2,875	72,700	5,612	5,229	173	284	11,298
7	2	411	13	491	3,325	40,050	2,875	78,700	6,076	5,622	173	314	12,185
8	1	264	28	315	3,105	26,810	4,130	56,395	4,354	4,037	248	201	8,840
8	2	284	28	316	3,105	27,010	4,130	57,305	4,424	4,189	248	217	9,078
9	2	317	-	377	-	20,000	1,097	41,797	3,227	3,564	66	243	7,100
10	2	-	386	537	-	31,880	7,197	74,992	5,789	3,443	425	-	9,657
11	2	-	-	-	-	-	-	-	-	-	-	1,494	1,494
12*	2	-	-	-	-	-	-	-	-	-	-	-	-

\*Preliminary Treatment Only

WASTEWATER MANAGEMENT PROGRAM  
TABLE C3  
STORMWATER TREATMENT PLANT - LIQUID PHASE

Plan	Level	Separate Treatment				Stormwater to Municipal Plants Combined Treatment					Pipe Cost		Annual Compar. Value (\$1000/Yr.)
		ASWTP <sup>1</sup> MG/Yr.	SWTP <sup>2</sup> MG/Yr.	Plant Storage Capital Cost (\$1000)	Plant O & M (\$1000/Yr.)	MG/Yr.	Storage Capital (\$1000)	Plant Capital (\$1000)	Annual Capital Cost (\$1000/Yr.)	O & M (\$1000/Yr.)	Capital (\$1000/Yr.)	Annual Capital Cost (\$1000/Yr.)	
1	1	74,254	-	747,886	57,737	3,718	-	-	-	-	345,824	25,072	88,683
1	2	74,254	-	1,306,500	100,861	21,816	-	-	-	-	345,824	25,072	149,905
2	1	74,254	-	747,886	57,737	3,718	-	-	-	-	345,824	25,072	88,683
2	2	74,254	-	1,306,500	100,861	21,816	-	-	-	-	345,824	25,072	149,905
3	1	9,704	-	122,250	9,437	536	65,072	1,811,986	110,272	139,362	372,247	26,987	203,049
3	2	9,704	-	197,300	15,232	4,260	65,072	1,811,986	163,856	144,017	372,247	26,987	220,476
4	1	-	18,061	50,972	3,935	801	55,711	1,475,205	112,933	115,670	278,000	20,155	156,541
4	2	-	18,061	50,972	3,935	801	55,711	1,475,205	112,933	115,670	278,000	20,155	156,541
5	1	57,546	-	533,150	41,160	2,749	15,492	775,190	21,110	57,830	222,000	16,095	124,735
5	2	57,546	-	875,009	67,550	16,256	15,492	775,190	31,600	58,640	236,663	17,158	169,023
6	1	58,085	-	543,021	41,921	2,749	16,111	670,840	18,799	50,088	297,000	21,532	124,106
6	2	58,085	-	875,009	67,550	16,256	16,111	670,840	29,735	50,930	304,143	22,050	165,034
7	1	32,712	3,125	266,870	26,304	1,909	38,345	872,515	44,211	66,670	357,249	25,900	136,718
7	2	32,712	3,125	386,870	29,866	7,770	38,345	872,515	59,861	67,879	358,000	25,955	149,877
8	1	7,617	32,541	369,163	26,764	2,316	33,053	837,605	46,050	64,281	354,000	25,660	131,376
8	2	7,617	32,541	410,248	31,677	3,998	33,053	837,605	52,385	64,770	354,000	25,665	139,120
9	2	5,463	-	117,800	9,094	2,049	69,404	3*	103,380	7,981	2,125,407	154,092	198,411
10	2	9,704	-	197,300	15,232	4,260	65,072	1,811,980	163,856	144,017	372,247	26,987	220,476
11	2	9,704	-	197,300	15,232	4,260	65,072	1,811,980	95,063	138,706	372,247	26,987	214,298
12	2	-	25,613	11,222 <sup>4</sup>	866	696	48,530	3*	-	-	2,720	1,425,931	115,128

<sup>1</sup>ASWTP - Separate Stormwater Treatment Discharging to Waterway  
<sup>2</sup>SWTP - Separate Stormwater Treatment Discharging to Land Treatment

<sup>3</sup>Storage Capital Included in Pipe Capital Figure  
<sup>4</sup>Storage Only

WASTEWATER MANAGEMENT PROGRAM  
TABLE C4  
STORMWATER TREATMENT PLANT - SOLID PHASE

Plan	Level	Sedimentation and Storage Sludge			Treatment Sludge			Total Capital Cost (\$1000)	Annual Capital Cost (\$1000/Yr.)	Total O & M (\$1000/Yr.)	Annual Compar. Value (\$1000/Yr.)
		Dry Tons Per Year	Capital (\$1000)	O & M (\$1000/Yr.)	Dry Tons Per Year	Capital (\$1000)	O & M (\$1000/Yr.)				
1	1	124,067	27,293	2,225	-	-	3,141	27,293	2,107	5,302	7,409
1	2	206,376	31,335	2,884	-	-	4,900	31,335	2,419	7,784	10,203
2	1	124,067	27,293	2,225	-	-	3,141	27,293	2,107	5,302	7,409
2	2	206,376	31,335	2,884	-	-	4,900	31,335	2,419	7,784	10,203
3	1	76,493	18,790	1,124	8,190	10,950	3,265	29,740	2,295	4,389	6,684
3	2	124,321	23,020	1,166	8,190	10,950	4,722	34,810	2,687	5,880	8,567
4	1	60,124	4,760	1,694	31,117	10,215	1,995	14,975	1,156	3,689	4,845
4	2	86,107	5,800	1,904	31,117	10,215	2,422	16,015	1,236	4,326	5,562
5	1	120,226	30,560	2,253	11,174	5,060	3,898	35,620	2,750	6,151	8,901
5	2	200,034	37,945	2,943	1,967	5,060	5,429	43,005	3,319	8,372	11,691
5	1	120,226	30,560	2,253	11,174	5,060	3,898	35,620	2,750	6,151	8,901
6	2	200,034	37,945	2,943	1,967	5,060	5,429	43,005	3,319	8,372	11,691
7	1	80,737	11,900	2,024	22,262	9,980	2,517	21,880	1,689	4,541	6,230
7	2	115,359	14,630	2,755	22,262	9,980	2,770	24,610	1,900	5,525	7,425
8	1	81,138	15,920	1,303	3,983	7,930	3,110	23,850	1,841	4,413	6,254
8	2	138,140	20,830	1,577	3,983	7,930	4,562	28,760	2,220	6,139	8,359
9A	2	95,865	-	3,393	17,845	10,360	1,283	10,360	800	4,676	5,476
10	2	124,321	18,695	1,166	8,190	10,075	3,651	28,770	2,221	4,817	7,038
11	2	124,321	-	1,166	8,190	-	43	-	-	1,209	1,209
12	2	98,831	5,800	2,343	31,117	10,115	2,422	16,015	1,236	4,765	6,001

CONCRETE/EARTH BREAKDOWNS

TABLE C5

<u>Plan</u>	<u>Volume (mg/yr)</u>		<u>(mg)</u> <u>Storage Volume</u>		<u>Capital Cost</u> <u>Storage (\$1000)</u>		<u>No. of Basins</u>	
	<u>Concrete</u>	<u>Earth</u>	<u>Concrete</u>	<u>Earth</u>	<u>Concrete</u>	<u>Earth</u>	<u>Concrete</u>	<u>Earth</u>
1	41,107	33,389	2,815	2,310	427,995	24,414	36	97
2	41,107	33,389	2,815	2,310	427,995	24,414	36	97
3	41,267	32,697	7,813	6,176	1,879,030	32,479	38	98
4	40,577	32,993	7,206	5,078	1,485,840	25,216	35	91
5	39,574	34,489	4,105	2,918	958,080	23,531	33	98
6	39,574	34,489	4,105	2,918	958,080	23,531	33	98
7*	34,197	29,926	4,283	4,837	1,042,300	27,083	37	94
8	42,468	31,060	3,990	4,627	982,705	26,466	39	88
9	41,800	31,120	7,626	6,224	1,640,070	29,415	48	74
10	41,267	32,697	7,813	6,176	1,879,030	32,479	38	98
11	41,267	32,697	7,813	6,176	1,879,030	32,479	38	98
12	40,577	32,993	7,206	5,078	1,261,130	25,216	35	91

\*Easterly  
Off-Shore Storage

9,107

1,821

5,000

1

### 3. - COST SUMMARY

Table C6 summarizes the costs for Plans 1 through 12 as developed for the wastewater and stormwater portions of the cost estimation as previously described. It should be noted again that the cost summaries as presented here are not the entire plan costs in that they include no cost for land treatment of wastewater, stormwater, or sludge and no cost for industrial waste pretreatment.

It should be further noted that with Plan 11, there has been no attempt to consider the outstanding bonded indebtedness of existing plants that would be abandoned. This would increase the annual cost. The Plan 11, physical-chemical, cost estimates do not have the same degree of reliability as the biological systems since the history of actual construction cost is limited.

TABLE C6  
ANNUAL COMPARITIVE VALUES\*  
(\$1,000,000/Yr)

Plan	Level	Wastewater		Stormwater		TOTAL
		Liquid	Solid	Liquid	Solid	
1	1	68	15	87	7	177
1	2	99	16	143	10	268
2	1	43	6	87	7	143
2	2	43	6	143	10	212
3	1	72	12	203	7	294
3	2	104	13	220	9	346
4	1	44	6	157	5	212
4	2	44	6	157	6	213
5	1	70	12	125	9	216
5	2	103	13	169	12	297
6	1	56	9	124	9	198
6	2	73	10	165	12	260
7	1	75	11	137	6	229
7	2	97	12	150	7	266
8	1	50	9	131	6	196
8	2	59	9	139	8	215
9	2	59	7	198	5	269
10	2	104	10	220	7	341
11	2	116	1	214	1	332
12	2	7	-	115	6	128

\*These costs include no costs associated with land treatment.

## D - RELATED INFORMATION

### 1. ELECTRICAL POWER REQUIREMENTS

The electric power requirements needed to treat a given volume of wastewater were obtained from Figure D1. Four basic plots are included in this figure. These represent power requirements per million gallons of wastewater for primary and secondary treatment, state goals (Level 1), federal goals (Level 2) and aeration for pre-treatment.

In computing values for plotting the primary and secondary treatment curve, the electric power requirement was computed for treatment plants having a wide range of average plant flows. The ratio of kilowatt-hours to million gallons treated was computed for these various plants initially for only the diffused, single-stage aeration assuming 1.5 cubic feet of air required per gallon, 25 cubic feet of air produced per minute per horsepower and the conversion from horsepower to kilowatts (taking into consideration motor efficiencies, etc.). The power required for the aeration process was then assumed to be approximately 60% of the total KWH/MG for primary and secondary treatment excluding pumping.

Computation of power requirements for state goals (Level 1) includes power consumed in primary treatment, aeration and by the use of microstrainers. Five horsepower is needed for every 10 MGD for the microstrainers. Aeration, which is a combination of 0.7 cu.ft./gal. for high rate activated sludge, 1.5 cu.ft./gal. for nitrifying activated sludge, and 0.1 cu.ft./gal. for post-aeration, requires a direct ratio of cu.ft./gal. to the power required for the aeration process of the primary-secondary process. Here, 2.3 cu.ft. of air per gallon is required compared to 1.5 cu.ft. per gallon of the primary-secondary process. Power for the primary treatment process is the same as the previous power requirements for this process.

O.C.E. goal (Level 2) treatment power requirements are a combination of electric power used for carbon adsorption, aeration, denitrification mixing, and primary treatment. The power requirement for carbon adsorption is based on a total dynamic head of 20 feet and the conversion from horsepower to kilowatts. Primary treatment requires 40% of the power required for the combined primary and secondary process. Aeration, which is a combination of high rate activated sludge aeration (.7 cu.ft./gal.), nitrifying activated sludge aeration (1.5 cu.ft./gal.), denitrifying reaeration (0.1 cu.ft./gal.), and post-aeration (0.1 cu.ft./gal.), requires a direct ratio of cu.ft./gal. to the power required for the aeration process of the primary-secondary process. Here, 2.4 cubic feet of air per gallon is required compared to the 1.5 cubic feet per gallon of the primary-secondary process. Five horsepower is required per MGD for the denitrification mixing process.

Power requirements for pre-treatment aeration is a constant 700 kilowatt-hours per million gallons. This is obtained by assuming an electrical power cost of \$7/MG at a rate of 1.21¢ per kilowatt-hour.

Using Figure D1\*, the power required for each plan was computed. The average plant size for each particular plan was entered onto the abscissa of Figure D1 and the power requirement in kilowatt-hours per million gallons was read off the curve of the appropriate treatment level. This power requirement (KWH/MG) was then multiplied by the total flow for each plan for the total power required. The power required for each plan is summarized on Table D1. The total cost for power for each plan can be computed by multiplying 1.21¢/KWH times the power required in the aforementioned table.

\*Federal Goals refer to standards established by O.C.E. (Office of the Chief of Engineers).

TABLE D1

ELECTRICAL POWER REQUIREMENTS

	<u>FLOW (MGD)</u>		<u>Pre-Treatment</u>	<u>Secondary</u>	<u>POWER REQUIREMENTS (MEGAW/DAY)</u>		
	<u>Secondary</u>	<u>TYPE OF PLANT</u>			<u>Pre-Treatment</u>		
		<u>Tertiary</u>				<u>Primary</u>	<u>Tertiary</u>
1		794			2040		
2	794			1730			
3		794			2460		
4	794			1730			
5	26	768		91	2700		
6	393	401		965	961		
7	26	768		91	2080		
8	600	194		1380	520		
9	8	458	318	25	1140	35	
10		794			2460		
11		794			2460		
12			794				557

# ELECTRIC POWER REQUIREMENTS

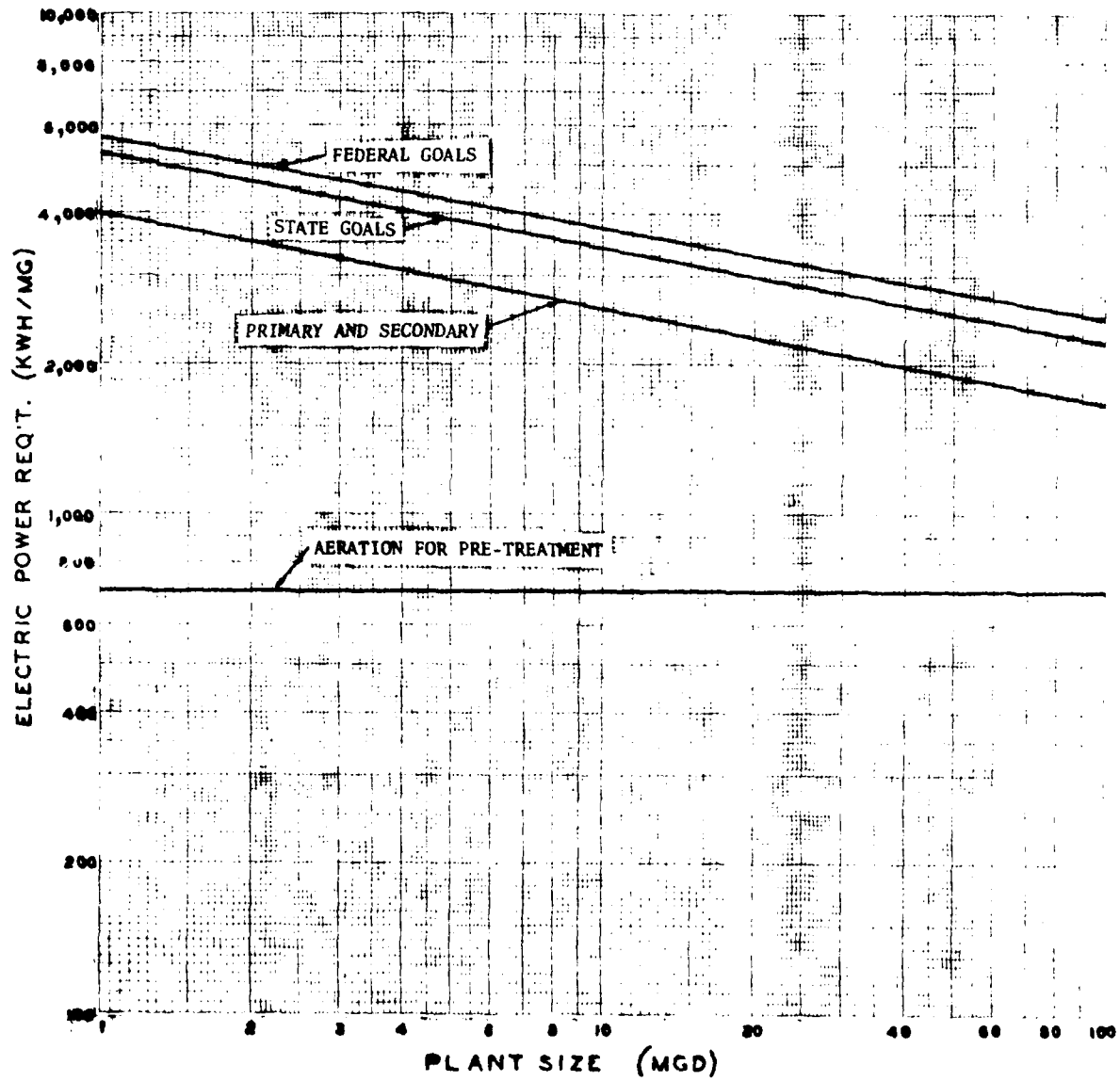


FIGURE D1

## 2. WASTEWATER TREATMENT CHEMICAL REQUIREMENTS

A breakdown of the daily chemical requirements for various treatment processes is summarized on Table D2. Chemicals needed for both the biological and physical-chemical treatment systems are shown for a basic system, state goals (Level 1), O.C.E. goals (Level 2), and the ultimate reuse applications. Each chemical additive is broken down into a requirement in pounds per day as taken from the mass balance diagrams for each process. The more stringent goals require more chemicals for both treatment systems while the physical-chemical process requires from 2 to 4 times as many chemicals as the biological process.

Table D3 illustrates chemical requirements necessary for each type of treatment implemented per plan for wastewater only. Plans meeting federal goals require the most chemicals except where physical-chemical treatment is utilized as in Plan 11. Plan 12 requires no chemicals since it only involves the pre-treatment processes. The values for Table D3 were obtained by multiplying the total flow in each plan for each distinct process by the total requirements needed in that process as shown on Table D2.

TABLE D2

CHEMICAL REQUIREMENTS

Treatment Process	Lime & FeCl3 (#/day)	(pounds per day per mgd)					Polymer (#/day)	Methanol (#/day)	CaO (#/day)	Total (#/day)
		Cl2 (#/day)	Al+3 (#/day)	Ca(OH) 2 (#/day)						
Basic Biological Treatment System	70	66	-	-	-	-	-	-	-	136
Basic Phys-Chem Treatment System	-	-	-	-	-	14	-	-	720	734
Basic Bio. Treatment System (State Goals)	-	50	111	420	-	3	-	-	-	584
Basic Phys-Chem Treatment Sys. (S. Goals)	-	860	-	500	-	13	-	-	1050	2423
Basic Bio. Treatment System (Fed. Goals)	-	33	122	470	-	3	420	-	-	1048
Basic Phys-Chem Treatment Sys. (Fed. Goals)	-	860	-	500	-	13	-	-	1050	2423
Basic Bio. Treatment System (Ultimate Reuse)	-	33	122	470	-	3	420	-	-	1048
Basic Phys-Chem Treatment Sys. (Ultimate Reuse)	-	860	-	500	-	13	-	-	1050	2423

TABLE D3

## CHEMICAL REQUIREMENTS PER PLAN

(pounds per day)

Plan	Secondary	Biological (State Goals)	Biological (Fed. Goals)	Phys-Chem (State Goals)	Phys-Chem (OCE. Goals)	Totals
1	-	425,000	-	49,400	-	474,400
2	118,000	-	-	-	-	118,000
3	-	-	833,000	-	-	833,000
4	118,000	-	-	-	-	118,000
5	3,540	442,000	-	-	-	445,540
6	53,500	234,000	-	-	-	287,500
7	3,540	-	805,000	-	-	808,540
8	81,600	-	203,500	-	-	285,100
9	44,600	-	488,000	-	-	532,600
10	-	-	833,000	-	-	833,000
11	-	-	-	-	1,925,000	1,925,000
12	-	-	-	-	-	-

### 3. STORMWATER TREATMENT CHEMICAL REQUIREMENTS

The chemicals required for treatment of stormwater runoff and combined sewer overflows are illustrated in Table D4. State goals (Level 1) require no chemicals for both types of flows while it is necessary to use 872 #/MG and 2310 #/MG of chemicals for stormwater runoff and combined sewer overflows respectively for O.C.E. goals (Level 2).

Table D5, which is a breakdown of chemical requirements per plan for stormwater and combined sewer overflow treatment, was formulated by multiplying the total requirements in #/MG in Table D4 for the various treatment processes by the flow in each plan for each distinct process. Plan 11 requires the most chemicals because of the physical-chemical treatment involved in municipal plant treatment while Plans 1 and 2 require no chemicals since all treatment meets only State goals without any municipal plants handling stormwater.

TABLE D4

## - CHEMICAL REQUIREMENTS -

STORMWATER & COMBINED SEWER OVERFLOW TREATMENT

TREATMENT PROCESS	POWDERED ACTIVATED CARBON(#/MG)	ALUM(AL <sup>+3</sup> ) (#/MG)	POLYMER (#/MG)	GRANULAR ACTIVATED CARBON(#/MG)	CL <sub>2</sub> (#/MG)	CA(OH) <sub>2</sub> (#/MG)	TOTAL (#/MG)
STORMWATER TREATMENT (OCE GOALS)	830	8	8	26	—	—	872
COMBINED OVERFLOW TREATMENT (OCE GOALS)	1000	100	4	26	430	750	2310
STORMWATER TREATMENT (STATE GOALS)	—	—	—	—	—	—	0
COMBINED OVERFLOW TREATMENT (STATE GOALS)	—	—	—	—	—	—	0

TABLE D5

CHEMICAL REQUIREMENTS (#/DAY) PER PLAN FOR  
STORMWATER & COMBINED SEWER OVERFLOW TREATMENT

PLAN	LEVEL	SEPARATE STORMWATER	COMBINED OVERFLOW	MUNICIPAL PLANT	TOTAL
1	1	_____	_____	_____	0
2	1	_____	_____	_____	0
3	2	6,170	45,500	187,000	238,670
4	2	26,200	45,500	20,800	92,500
5	1	_____	_____	24,560	24,560
6	1	_____	_____	8,980	8,980
7	2	68,500	45,500	106,500	220,500
8	2	65,500	80,000	46,650	192,150
9	2	8,150	13,000	126,190	147,340
10	2	6,170	45,500	187,000	238,670
11	2	6,170	45,500	434,500	486,170
12	2	51,500	4,070	_____	55,570

APPENDIX A  
REFERENCES

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21. Burgess & Niple, Ltd., "Design Criteria for Northeast and Southwest Ohio Water Development Plans", Ohio Department of Natural Resources, September, 1971.

APPENDIX B  
PLANNING INPUT

During the course of this study, the following people, firms, and agencies were contacted for information or input.

1. Tri County Regional Planning Commission.
2. Geauga County Planning Commission.
3. Department of Natural Resources, State of Ohio.
4. Mr. George Garrett, Department of Health, Division of Sanitary Engineering, State of Ohio.
5. Three Rivers Watershed District.
6. Geauga County Sanitary Engineers.
7. Portage County Sanitary Engineers.
8. Medina County Sanitary Engineers.
9. County Sanitary Engineers, Group of Northeast Ohio.
10. Burgess and Niple, Consulting Engineers.
11. Willard Schade and Associates, Consulting Engineers.
12. Alden Stilson and Associates, Consulting Engineers.
13. Berlie L. Schmidt, Ohio Agricultural Research and Development Center.
14. James M. Beattie, Ohio Agricultural Research and Development Center.
15. Michael Benza, Jr., Consulting Engineer.
16. Lewis DeBevec, City of Akron.

# APPENDIX C: DISCHARGE REQUIREMENTS TO SURFACE WATERS

Goal II - Federal Government

Goal I - State of Ohio

- Item

Settleable Solids	Substantially complete removal - monthly ave. max. 0.3 ml/l 1.0 ml/l	Trace
Oils (and grease)	Lowest practical level attainable by today's technology monthly ave. 10 mg/l max. 20 mg/l	Trace
Debris, Scum, Flotables	Substantially complete removal	None
Suspended Solids (Inert)	Reduction to such a degree as to not cause noticeable turbidity in the receiving stream, but shall not exceed:	< 5 mg/l
	Free Flowing Warm Water Fisheries Cold Water Fisheries, Pooling Streams, Scenic Rivers, Reservoirs and Inland Lakes	
	Monthly Ave. 30 mg/l Maximum Daily 45 mg/l Monthly Ave. 20 mg/l Maximum Daily 30 mg/l	
Color	Effluent imparts no objectionable color nor increases the background level by 5 standard units.	< 75 Color Units
Taste and Odor	Reduction to such a degree as to not cause an objectionable odor, a threshold odor number 724 to potable water supplies, nor cause fish flesh tainting.	Non Offensive
"Toxic" Constituents and Heavy Metals	Reduction of any and all materials to such a degree that the concentration thereof, singly or in combinations, in any discharge is not harmful to human health or aquatic life to such a degree that the concentration thereof in the discharge does not kill 25%+ of a mixed fish population common to the receiving stream in a 1:1 dilution of the sample with waters of the receiving stream provided that the calculated concentration in the receiving stream does not exceed 1/20 of the 96 hour median tolerance level.	Critical levels for all constituents not specifically mentioned shall be based upon natural background levels of the receiving watercourse or aquifer with exception of constituents that are highly toxic or injurious to the environment at trace levels. If current State water quality standards are higher, these standards shall apply; or levels of nontoxic constituents may be relaxed upward (above background levels) should they be proven to be not injurious to the environment of the region.
Arsenic	0.05 mg/l	Absent (not detectable by standard methods and current technology)
Barium	1.0 mg/l	"
Cadmium	0.01 mg/l	"
Chromium (hex.)	0.05 mg/l	"
Chromium (tot.)	0.30 mg/l	"
Copper	1.0 mg/l	"
Iron (total)	5.0 mg/l	No Comment
Iron (soluble)	0.3 mg/l	"
Lead	0.05 mg/l	Absent
Mercury	0.005 mg/l	"
Nickel	0.01 mg/l	"
Silver	0.05 mg/l	"
Zinc	5.0 mg/l	"

APPENDIX C: DISCHARGE REQUIREMENTS TO SURFACE WATERS (CONT'D.)

Goal II - Federal Government

Goal I - State of Ohio

Item  
Phosphorus

Volume of Wastewater  
mgd

Effluent Concentration  
mg/l - P

1975 1980

Discharges to:

(a) Free Flowing Tributaries of Lake Erie

10+ 1.0 0.5  
1-9.9 1.0 1.0  
1.0 8.0 1.0

(b) Free Flowing Tributaries of the Ohio River

50+ 1.0 0.5  
10-49.9 2.0 1.0  
1.0-10 8.0 2.0

(c) Lakes, Reservoirs, Significant Impoundments and Pools

10+ 2.0 0.5  
1.0 5.0 1.0

(A) Warm Water Fisheries

Reduction of heat content so that in no case  
the discharge increase the river temperature by  
more than 5°F., if below the following formula  
applies:

Allowable Heat Discharge Rate (BTU/Sec. = 62.4 (River Flow, CFS)  
(TA - TR) (90°)

TA = Allowable Maximum River Temp.

Month Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
TA 50 50 60 70 80 90 90 90 78 70 57

TR = River Temp. (daily ave.) above discharge

Nt. Comment

Turbidity

< 5 Jackson Units

< ± 1°C. (1.8°F.) of ambient water temperature

# APPENDIX C: DISCHARGE REQUIREMENTS TO SURFACE WATERS (CONT'D.)

## Goal I - State of Ohio

Control to such a point that the discharged dissolved solids load does not increase the dissolved solids concentration in the receiving waters by more than 5% on a calculated basis provided that (a) the dissolved solids criterion in the receiving waters is not exceeded, or (b) the dissolved solids concentration in the discharge does not exceed five times the dissolved solids criteria for the receiving water.

4.0 mg/l + for streams classified as warm water fisheries  
6.0 mg/l + for streams classified as cold water fisheries

Setting Wastes  
(and SS)

Reduction so that DO level of receiving stream is not depressed below established criteria and in accordance with the following criteria.

Class I - Cold Water Fisheries  
Effluent conc. (monthly) can be if ave. BOD5 conc. increase at critical

BOD5-mg/l	SS-mg/l		Flow in Stream is	
	Mon.Ave.	Max.Day	Mon.Ave.	Max.Day
15	23	25	15	25
10	15	18	10	18
7	10	15	7	15
5	8	12	5	12

Class II - Scenic Waters, Streams, Reservoirs, Lakes

15	23	25	15	25
10	15	18	10	18
7	10	15	7	15
5	8	12	5	12

Class III - Free Flowing Warm Water Fisheries  
(Free flowing for at least 15 ft. below discharge)

30	45	50	30	50
25	40	45	25	45
20	35	40	20	40
15	30	35	15	35
10	25	30	10	30
7	20	25	7	25
5	15	20	5	20

## Goal II - Federal Government

<500 mg/l w/species limits established for specific inorganics, i.e.  
CO2 <25 mg/l  
SO4 <10 mg/l  
Ca <30 mg/l  
Cl <250 mg/l  
Na <10 mg/l  
Mg <125 mg/l  
F <1.7 mg/l @ 1° C. to 0.8 mg/l @ 30°C.  
Al <1 mg/l  
HCO3 <± 50 mg/l variation over ambient conditions  
Mn <0.5 mg/l

No maximum except BOD5 level < effluent DO

BOD5 < 5 mg/l  
SS < 5 mg/l

APPENDIX C: DISCHARGE REQUIREMENTS TO SURFACE WATERS (CONT'D)

Goal I - State of Ohio

Item  
Deoxygenating Wastes  
(BOD<sub>5</sub> and SS)  
Conc'd.

Class IV - Polluting Stream, Impoundments, Lake Waters and  
Lakes Classified for Warm Water Fisheries

Non-point Pollution	SS-mg/l	Flow in Stream is more than mg/l
15	10	0.5
15	10	1
15	10	2
15	10	3
15	10	5

Exceptions for Class III and IV Waters

A) In congested, heavily populated and industrial corridors where discharges of a number of industries contribute to a single or multiple water quality violations - additional reductions will be required as follows:

- 1) Additive effects of multiple discharges shall not exceed required level of discharge of the combined source of pollutants, or
- 2) Effluent reductions will be determined by river stream's immediate allotment of waste loads provided no discharge exceeded requirements for Class III and IV streams.

B) If stream depth is less than 1.6' and free of pollution - allowable potential increase in BOD<sub>5</sub> is 50%.

C) For 15' of dry weather flow or less and an untreated waste load of 100 lbs. that discharges to a dry weather stream and for any flow less than the only practical method of treatment, all other effluent quality will be 100% BOD<sub>5</sub> = 100 mg/l.

Ammonia Nitrogen

Stream Classification

Stream Classification	Ammonia Nitrogen	Order listed stream
Class IV	1.00	0.10
Class III	1.00	0.05
Class II	1.00	0.10
Class I	1.00	0.15

< 1.0 mg/l

Organic Nitrogen

Stream Classification

Stream Classification	Organic Nitrogen
Class IV	1.00
Class III	1.00
Class II	1.00
Class I	1.00

Total Nitrogen < 5 mg/l

< 1.0 mg/l

Phosphorus and Nitrites

Stream Classification

Stream Classification	Phosphorus and Nitrites
Class IV	1.00
Class III	1.00
Class II	1.00
Class I	1.00



U.S. ARMY CORPS OF ENGINEERS  
BUFFALO DISTRICT

SURVEY SCOPE STUDY  
FOR  
WASTEWATER MANAGEMENT PROGRAM

Contract Phase Report  
Phase III  
*Time Phasing of*  
Selected Alternatives

Prepared by  
HAVENS AND EMERSON, LTD.  
Cleveland, Ohio

October, 1972  
Under Contract No.: DACW49-72-C-0048

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## INTRODUCTION

The Cleveland-Akron area was chosen by the Corps of Engineers as one of the five pilot areas in which to develop a wastewater management program. This Survey Scope Study is a continuation of the preliminary work performed under the Feasibility Study in 1971.

The planning efforts of this program have been divided into the following areas: plan formulation, domestic wastewater and stormwater runoff, industrial wastewater, land treatment, and plan evaluation. Havens and Emerson, Ltd. has been responsible for the domestic wastewater and stormwater runoff portion.

Phase I of the study identified the wastewater management problem with respect to domestic wastewater and stormwater runoff as it exists today and as it is anticipated to exist in the future.

Phase II of the study identified treatment processes and effectiveness, design criteria, and unit costs associated with municipal wastewater treatment facilities and stormwater treatment facilities. Also included were cost estimates of twelve alternative plans for wastewater management of the study area.

Upon completion of Phase II, three of the alternative plans were chosen by the Corps of Engineers for further investigation. This Technical Appendix covers Phase III of the study, which will develop a thorough cost presentation of these three plans, present recommendations for early action programs, and evaluate related environmental effects.

## A - METHODOLOGY

### 1. WASTEWATER MANAGEMENT GOALS

Level 1 represents the proposed effluent standards of the State of Ohio. Level 2 represents the O.C.E. Standards for wastewater treatment effluents. The Phase II report discusses these wastewater management goals in detail.

The twelve alternative plans formulated in Phase II of the study were designed to achieve either Level 1 or Level 2 effluent criteria. In other words, not all plans were specifically formulated to achieve the same effluent criteria. However, in the wastewater and stormwater treatment portion of the Phase II study, costs for Plans 1 through 8 were computed based on achieving both Level 1 and Level 2, to better evaluate the merits of each plan.

In Phase III, the achievement of the wastewater management goals are based upon guidance provided by the Corps of Engineers (NCBED-PB 31 January 1973) to comply with the Corps interpretations of the Federal Water Pollution Control Act of 1972. New construction or expansion will be phased according to the following schedule:

#### Municipal and Industrial Wastewater

- a. Secondary Treatment by 1977
- b. Level 1 by 1983
- c. Level 2 by 1985

#### Stormwater and Combined Overflow Runoff

- a. Combined Overflow to Level 1 by 1980
- b. Separate Stormwater to Level 1 by 1983
- c. All Runoff Treatment to Level 2 by 1985

Therefore, the three alternative plans for this portion of the study will all be at Level 2 by 1985, for all wastewaters.

## 2. BASIS OF DESIGN

2.1 MUNICIPAL WASTEWATER. Future wastewater flows and loads to municipal plants were established in Phase I, Part A, of the Survey Scope Study. This was accomplished through a systematic development of land use and population projections along with estimates of future per capita wastewater flows and loads.

Also defined in the Phase I, Technical Appendix, were characteristics of the existing wastewater treatment plants, including type of treatment, treatment efficiencies, cost of treatment, and present worth. In addition, the 1980 sewerage districts were also defined.

The above data coupled with the industrial flow projections from AWARE, Inc., resulted in design flows by decade for each of the sewerage districts in the study area. These design flows were used in this portion of the study to time phase construction of each plant in each of the three selected plans. The computer printout sheets in Section C present the projected domestic and industrial flows by decade for each of the municipal plants.

2.2 STORMWATER. Future stormwater flows and loads were established in Phase I, Part B, of the Survey Scope Study. This was done for each of the 162 drainage districts which, in total, encompass the entire present and future urban area. For each of these districts, drainage criteria and runoff factors were developed.

After careful consideration and much deliberation, the one year storm was selected as the design storm for the stormwater treatment facilities. This selection of the one year design storm and the associated stormwater treatment techniques provide partial protection to the receiving waters from runoffs greater than the one year storm runoff. See the Phase II.

Technical Appendix. A generalized unit hydrograph was developed and applied to predict hydrographs for the six-hour duration, one year storm for each of the drainage districts. Quality characteristics were also investigated and established for combined sewer overflows and separate system stormwater.

Using the above data, stormwater flows and loads were calculated by decade up to 2020. As discussed in the Phase II, Technical Appendix, the stormwater flows from presently undeveloped areas were adjusted to account for the use of the Planned Urban Development (P.U.D.) concept. The computer printout sheets in Section C present the one year storm volume and annual volume by decade for each of the storm drainage districts. These figures reflect the adjusted flows for the P.U.D. concept, if applicable.

### 3. DESIGN CRITERIA

3.1 MUNICIPAL WASTEWATER. Treatment schemes to achieve Level 1 and Level 2 effluent criteria have been established for advanced biological plants and for physical chemical plants. The Phase II, Technical Appendix, Part A, contains detailed mass balances of these treatment schemes in addition to related unit costs of these facilities.

The alternative plans under investigation are a combination of various treatment schemes. When water-based treatment is designated for a particular sewerage district, the schemes previously described are used to attain the designated effluent criteria. When land-based treatment is designated, secondary treatment is provided prior to land application.

In addition to defining the various treatment schemes and related costs, the Phase II, Technical Appendix, also establishes design criteria for other elements of the treatment system, including pump stations, gravity sewers, force mains, and outfall sewers.

The design criteria for the wastewater treatment plants was established in the Phase II portion of the study.

3.2 STORMWATER. Treatment schemes to achieve Level 1 and Level 2 effluent criteria have been established for combined sewer overflows and separate system stormwater. Variations of these treatment schemes are dependent upon the type of stormwater (combined overflow versus separate system), the type of storage (concrete versus earth), drainage district location (separate facilities versus treatment at municipal plants), and the level of treatment required (Level 1 versus Level 2).

The Phase II, Technical Appendix, Part B, contains detailed mass balances of the treatment schemes, in addition to related unit costs of these facilities. Also contained in that report is a complete description

of the variations previously mentioned and their relative economic effect on the alternative plans.

The design criteria for the stormwater treatment facilities was established in the Phase II portion of the study.

#### 4. COST ESTIMATING TECHNIQUE

4.1 ECONOMIC COMPARISON. In Phase III, the principal concern is to make an equitable economic comparison of alternative plans selected for facility program phasing. The three items of principal concern in making the economic comparisons are:

1. The plans are composed of structures and facilities which have different useful lives varying from twenty to sixty years, so that the residual value at some comparison date must be considered.
2. High capital expenditures occur at various decades up to 2020 with several occurring in the period of 1990-2020. This must be considered to make the plans with a high early capital cost comparable to plans where facilities can be expanded by decades with lower early capital cost requirements.
3. The plans have different operation and maintenance cost relationships through the period.

With due consideration to these concerns, the following procedure was developed after considerable study by the consultants and the evaluation team, for preparing the economic comparison:

1. All costs should be developed to 2020 using projections previously made. This provides for full implementation of each of the plans and also provides due benefits to those plans with low O & M costs in the later decades.
2. Capital costs should be adjusted to a present worth in 1972. This provides a common base for comparison, with allowance for the cost of implementation in future decades. Credit for the present worth of structures remaining after 2020 is given.

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WASTEWATER MANAGEMENT STUDY FOR CLEVELAND-AKRON AND THREE RIVER--ETC(U)

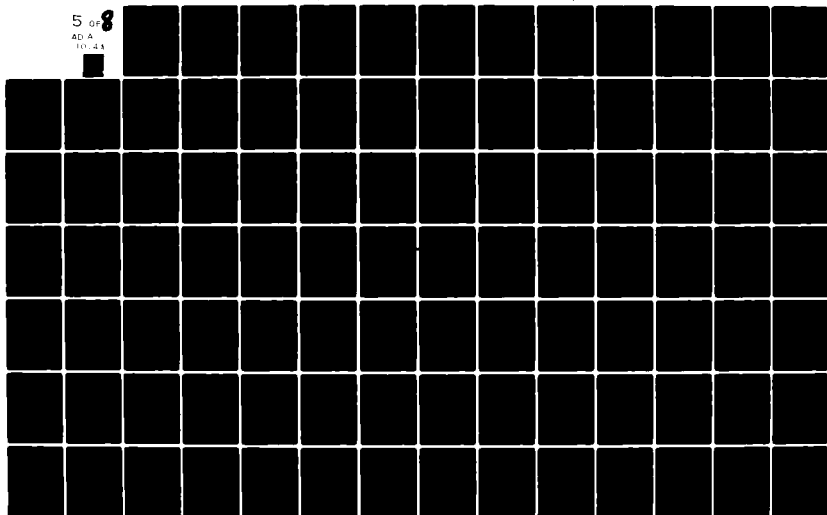
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3. O & M costs should be computed up to the year 2020 and adjusted to a present worth. This can be done by computing the average total O & M costs for successive 5 to 10 year periods.
4. The cost comparison of alternative plans should be made upon the sum of the present worth of the capital and O & M costs so computed.

Tables A1 and A2 illustrate the procedure for economic comparison for expansion of the Cleveland Southerly Sewage Treatment Plant.

Table A1 indicates the net capital cost for the Southerly plant up to the year 2020. The capital expenditure for plant and sludge facility expansion and for sewer construction are based on 1972 dollars. The present worths of these future structures were then computed and tabulated. In Row 1 of Table A1, it is shown that in the year 2000 the existing 96 mgd plant will have to be replaced. This replacement cost, based on 1972 dollars, is \$40,000,000. The present worth of \$40,000,000 in 1972 is \$6,016,000 using a present worth factor of 0.1504 (7% interest rate over a 28-year period 2000-1972). In 2020 this portion of the plant based on a straight line depreciation (35 year useful life) is worth \$17,100,000. These residual values in 2020 are discounted to 1972 and shown as a credit towards the plan. Rows 2 through 11 are further expansions and modifications. Row 12 is the total of all present worths.

Table A2 shows the O & M Cost for the Southerly Plant up to the year 2020. The O & M costs for various years up to 2020 were calculated including costs for plant and sludge facilities and sewers, based on 1972 dollars. An average period cost was developed between these years and adjusted to the total required at the beginning of the period. This total was then adjusted to a 1972 present worth. For the period between 1975 and 1980,

the average annual O & M cost was \$9,869,000 per year. The total required at the beginning of the period was \$40,463,000. This adjusted to a present worth yielded \$33,026,000. The present worth factor of 0.8162 was based on a 7% interest rate over a 3 year period (1975-1972). This same procedure was used to discount the remaining period O & M costs to a present worth.

The Net Capital Cost from Table A1 and the Net O & M Cost from Table A2 are added to become the total dollars required in 1972 to construct and operate the facilities of the plant until 2020. ( $\$163,780,000 + \$184,716,000 = \$348,496,000$ ). The summation of all of the plant or facility present worths then becomes the total 1972 dollars required to formulate and implement the plant and becomes the number for economic comparison of alternative plans.

4.2 ANNUAL COSTS. Annual costs have been computed to provide actual dollar expenditures by time period. This provides additional data to use in plan evaluation, but was not used for economic comparison of plans.

Table A3 presents the annual costs for expansion of the Southerly Sewage Treatment Plant as previously described in the Economic Comparison section. The itemized capital costs were calculated using a capital recovery factor based on an interest rate of 7% over the life of the structure.

It should be noted that annual costs do not reflect present outstanding bonded indebtedness.

TABLE A1  
CAPITAL COSTS (\$1,000)

Row	1972 Present Worth (\$1000)		Item	1975	1980	1985	1990	2000	2010	2020	Residual
	(+)	(-)									
1	\$ 6,016		Existing 96 mgd Secondary 35 yr. life					40,000			17,100
2	\$ 49,093		Level 1 182 mgd 35 yr. life	55,000					55,000		39,300
3	\$ 34,391		Level 2 206 mgd 25 yr. life			70,000			70,000		42,000
4	\$ 7,986		Level 1, Exp. 234 mgd 35 yr. life				27,000				3,900
5	\$ 3,384		Level 2, Exp. 234 mgd 25 yr. life					22,500			4,500
6	\$ 3,245		Existing 73 TPD 35 yr. life					21,580			9,200
7	\$ 22,600		Sewage 376 TPD 35 yr. life	25,320					25,320		18,100
8	\$ 3,283		Sewage (Exp.) 465 TPD 35 yr. life				11,100				1,600
9	\$ 32,648		Sewers - I 50 yr. life	40,000							4,000
10	\$ 6,744		Sewers - II 50 yr. life			16,256					4,900
11		\$ 5,610								Σ -	144,600
12	\$ 169,390	\$ 5,610									
Total Net Present Worth = \$163,780											

TABLE A2  
OPERATION AND MAINTENANCE COSTS

	1972	1975	1980	1985	1990	2000	2010	2020
Plant (\$1000/Yr.)	\$ 2,943	6,624	7,769	10,164	15,362	17,293	18,888	19,644
Sludge (\$1000/Yr.)	\$ 1,304	2,345	2,600	2,764	3,431	3,786	4,051	4,243
Sewers (\$1000/Yr.)	-	200	200	281	281	281	281	281
Total (\$1000/Yr.)	\$ 4,247	9,169	10,569	13,209	19,074	21,360	23,220	24,168
Average for Period (\$1000/Yr.)	\$ 6,708	9,869	11,889	16,141	20,217	22,290	23,694	
Present Value Factor	2.6243	4.1001	4.1001	4.1001	7.0235	7.0235	7.0235	
Total O&M Required @ Beginning of Period (\$1000)	\$17,603	40,463	48,746	66,179	141,994	156,553	166,414	
Present Worth Factor	1.00	.8162	.5820	.4149	.2958	.1504	.0764	
Present Worth	\$17,603	33,026	28,370	27,457	42,001	23,545	12,714	
Total Present Worth of O & M Costs \$184,716								

TABLE A3  
ANNUAL COSTS (\$1000/YR.)

Item	1972	1975	1980	1985	1990	2000	2010	2020	Capital Recovery Factors
Existing Secondary						3,088	3,088	3,088	.0772
Level 1		\$ 4,246	4,246	4,246	4,246	4,246	4,246	4,246	.0772
Level 2				6,006	6,006	6,006	6,006	6,006	.0858
Level 1, Exp.					2,084	2,084	2,084	2,084	.0772
Level 2, Exp.						1,930	1,930	1,930	.0858
Existing Sludge						1,665	1,665	1,665	.0772
Sludge, Exp.		\$ 1,954	1,954	1,954	1,954	1,954	1,954	1,954	.0772
Sludge, Exp.					856	856	856	856	.0772
Sewers		\$ 2,896	2,896	2,896	2,896	2,896	2,896	2,896	.0724
Sewers				1,176	1,176	1,176	1,176	1,176	.0724
Plant	\$ 2,943	6,624	7,769	10,164	15,362	17,293	18,888	19,644	-
Sludge	\$ 1,304	2,345	2,600	2,764	3,431	3,786	4,051	4,243	-
Sewers	-	200	200	281	281	281	281	281	-
Total	\$ 4,247	18,265	19,665	29,487	38,292	47,261	49,121	50,069	-

## B - PLAN SELECTION

Twelve alternative plans were designed, cost estimated, and evaluated in Phase II portion of the Survey Scope Study. Part C of our Phase II, Technical Appendix, presents the cost estimates of these plans relative to municipal wastewater treatment plants and stormwater plants.

In this report (Phase III), three of the twelve alternative plans have been investigated in more detail. The plans selected were Plans 1, 7, and 8. The Corps of Engineers made the final selections and prepared guidance for this phase which was presented to the Contractors. (Refer to NCBED-PB 19 December, 1972). Modifications of these original plans have been made to optimize these plans; therefore, the designation of those plans have been changed to Plan A, Plan B, and Plan C, respectively. Tables B1, B2 and B3 provide a generalized description by major areas for Plans A, B, and C.

A combination scheme of stormwater treatment has been investigated to take full economic advantage of adjacent land treatment sites and available capacities in municipal plants. Sludge handling techniques have also been modified to take full advantage of strip mine application in Harrison County.

A complete itemized cost estimate by time period has been made of the final three plans and is presented in Part C of this report.

Certain terminology has been adopted for convenience of this report. Advanced biological treatment refers to biological secondary treatment followed by various advanced treatment techniques involving physical, chemical and biological processes. Physical-chemical treatment refers to a process sequence in which the overall process is by these methods and biological processes are of minor importance.

Land treatment refers to the use of effluent from a secondary level treatment process, ultimately aerated lagoons in most cases, for irrigation either by spray irrigation or overland flow techniques. The Phase II Technical Appendix describes these processes in more detail.

## 1. PLAN A

Plan A is similar to Old Plan 1 and is basically a modification of present planning by the water planning agencies throughout the watershed to higher effluent levels. With Plan A, all plants are either advanced biological or physical-chemical with effluent discharged to the receiving water. Digested sludge is ultimately applied to strip mines or to agricultural lands within the basin. Table B1 shows the ultimate disposition of the generalized areas.

In the upper Rocky River basin, a single plant is proposed at Liverpool which will phase out Medina and the Medina County plant serving Brunswick. This will eliminate all effluent discharges upstream of this plant. The new plant will be an advanced biological plant, and it will also treat some stormwater. Digested sludge from this plant will be applied to local agricultural lands.

The Lakewood plant will be the only other plant in the basin after the Southwest Interceptor phases out the North Olmsted plant and the smaller plants serving the communities on the East Branch of the Rocky River such as Berea, Strongsville, North Royalton and Hinkley. The Southwest Interceptor is scheduled for construction in the early 1980's with the North Olmsted connection taking place in the early 1990's. Design of this interceptor is underway and allowances for the wastewater flows are being made in the Southerly Plant design.

Regionalization is limited in the upper Chagrin River. The plants will be located at Chagrin Falls, McFarland Creek, Aurora Central, Fowlers Mill, Newbury Township, Fairmount Road, and in the East Branch of the Chagrin. Digested sludge from these plants is applied to agricultural lands. In the lower Chagrin basin, the Willoughby-Eastlake plant becomes

a regional facility with its digested sludge being pumped through a pipeline to the strip mined areas for land reclamation.

The upper Cuyahoga basin will have eight small plants with sludge being applied to the agricultural lands. The eight plants are Burton, Middlefield, Auburn, Troy, East Claridon, Butternut Creek, Mantua and Randolph. The wastewater from the area west and south of Chardon is pumped to the Chardon plant and is discharged into the Grand River. Cost given are for pumping.

Kent is scheduled to be served by a new physical-chemical plant with incineration. Ravenna is an advanced biological plant with digested sludge going to the strip mine areas.

The three largest plants, Akron, Southerly, and Easterly are all advanced biological plants with digested sludge being pumped to the strip mine areas after 1990. These plants also treat some combined sewer overflow. The proposed Cuyahoga Valley Interceptor will deliver wastewater from the Central Cuyahoga basin to the Southerly Plant. This interceptor is scheduled for construction in the 1980-1990 period with the Tinkers Creek branch scheduled in the early 1990's.

The Westerly and Rocky River plants are both physical-chemical and are now under design and construction respectively. Both plants will continue to serve the area currently served. Westerly plant sludge is incinerated and Rocky River sludge is taken to agricultural land. The Euclid plant will be an advanced biological plant serving the area it now serves. Sludge will be pumped to the strip mine areas.

TABLE B1  
PLAN A - DESCRIPTION  
Plan A (Old Plan 1)

Area	MUNICIPAL WASTEWATER (76 Plants)				STORMWATER		
	In Basin	Land Based Treatment Out of Basin	Water Based Treatment	Sludge Handling	Land Based Treatment	Water Based Treatment	Sludge Handling
Upper Rocky	None	None	Regionalization of Medina area with an advanced biological plant constructed at the Liverpool site. (1 Plant)	Digested sludge disposal on agricultural lands.	None	Available capacity in the Liverpool plant was used to treat drainage districts during off peak hours. Individual stormwater treatment plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or land-fill.
Lower Rocky	None	None	North and other plants phased out by 1980-4 with construction of Southwest Interceptor. Lakewood expands to advanced biological plant. (1 Plant)	Digested sludge disposal on agricultural lands.	None	Individual stormwater treatment plants were used for the drainage districts with the exception of a combined sewer district in Berea which was connected to the Southwest Interceptor.	With one exception, only earth basins were used in this area. Therefore sludge is periodically removed for recycle or land-fill.
Upper Chagrin	None	None	Regionalization limited. Several small plants developed as advanced biological plants. (7 Plants)	Digested sludge disposal on agricultural lands.	None	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or land-fill.
Lower Chagrin	None	None	Willoughby-Eastlake plant developed as advanced biological plant. (1 Plant)	Digested sludge application to strip mines	None	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or land-fill.
Upper Cuyahoga	None	None	Regionalization limited. Several small plants developed as advanced biological plants. Chardon flow is pumped out of basin. (8 Plants)	Digested sludge disposal on agricultural lands.	None	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or land-fill.
Kent-Ravenna	None	None	Physical-Chemical plant at Kent. Advanced biological plant at Ravenna. (2 Plants)	Sludge application to strip mines from Ravenna. Incineration at Kent	None	Available capacity in the plants were used to treat drainage districts during off peak hours.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or land-fill.

TABLE B1 (Cont'd.)

Area	MUNICIPAL WASTEWATER (26 Plants)			STORMWATER			
	In Basin	Out of Basin	Water Based Treatment	Sludge Handling	Land Based Treatment	Water Based Treatment	
Akron	None	None	Advanced biological plant. (1 Plant)	Sludge application to strip mines.	None	Available capacity in the plant was used to treat some of drainage districts during off peak hours. Individual stormwater plants were used to treat the remaining districts.	Sludge from the concrete basins was taken to the municipal plant via sewers. Sludge from earth basins will be periodically removed for recycle or landfill.
Southerly	None	None	Advanced biological plant. (1 Plant)	Sludge application to strip mines.	None	Available capacity in the plant was used to treat some of drainage districts during off peak hours. Individual stormwater plants were used to treat the remaining districts.	Sludge from the concrete basins was taken to the municipal plant via sewers. Sludge from earth basins will be periodically removed for recycle or landfill.
Westerly	None	None	Physical chemical plant. (1 Plant)	Incineration	None	Available capacity in the plant was used to treat drainage districts during off peak hours.	Sludge from concrete basins taken to the municipal plant.
Easterly	None	None	Advanced biological plant. (1 Plant)	Sludge application to strip mines.	None	Available capacity in the plant was used to treat drainage districts during off peak hours.	Sludge from concrete basins taken to the municipal plant.
Lake Erie	None	None	Physical chemical plant at Rocky River. Advanced biological plant at Euclid. (2 Plants)	Digested sludge from Rocky River disposed of on agricultural lands. Euclid sludge applied to strip mines.	None	Available capacity in the plant was used to treat drainage districts during off peak hours.	Sludge from earth basins will be periodically removed for recycle or landfill.

## 2. PLAN B

Plan B is a modification of Plan A whereas a number of areas served by advanced biological plants under Plan A would remain as secondary plants with the effluent given land treatment as the advanced treatment process. All land treatment takes place within the Three Rivers Watershed basins except for the sludge which is taken to the strip mine area. Table B2 shows the ultimate plan for the generalized areas. In the upper Rocky River basin, for example, the single plant concept used for Plan A is replaced by six smaller secondary plants with effluent applied to the agricultural land within the basin. There is no change in the lower Rocky River basin over Plan A.

In the upper Chagrin River all of the advanced biological plants are replaced by secondary plants with effluent being applied to lands within the basin. Runoff from several stormwater districts is applied to the land. In the lower Chagrin River, the plan remains basically the same as in Plan A except for some stormwater districts.

In the Kent-Ravenna area, the only change is at the Ravenna Plant where the plant remains a secondary facility with land treatment within the basin rather than becoming an advanced biological plant.

Akron, Southerly, Westerly, Easterly, Rocky River and Euclid remain the same as in Plan A.

TABLE A7  
PLAN B - DESCRIPTION

MUNICIPAL WASTEWATER (31 Plants)					STORMWATER		
Area	In Basin	Out of Basin	Water Based Treatment	Sludge Landfill	Land Based Treatment	Water Based Treatment	Sludge Handling
Upper Rocky	Regionalization limited. Several smaller plants provide secondary treatment prior to land. (6 Plants)	None	None	Sludge disposed on agricultural lands.	Drainage in districts adjacent to land treatment sites was applied to the land following peak hours. Individual stormwater treatment plants were used for the remaining drainage districts.	Available capacity in the intercept plant was used to treat drainage districts during off peak hours. Individual stormwater treatment plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Lower Rocky	None	None	Port of Seattle is not involved in this area. Plants provide secondary treatment prior to land. (6 Plants)	Sludge disposed on agricultural lands.	None	Available capacity in the plants were used to treat off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Upper Chagrin	Regionalization limited. Plants provide secondary treatment prior to land. (6 Plants)	None	None	Sludge disposed on agricultural lands.	Drainage districts adjacent to land treatment sites were applied to the land following storage.	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Lower Chagrin	None	None	Although not involved in this area, plants provide advanced treatment prior to land. (1 Plant)	Sludge application to agricultural lands.	Drainage districts adjacent to land treatment sites were applied to the land following storage.	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Upper Cuvahoga	Regionalization limited. Plants provide secondary treatment prior to land application. (9 Plants)	None	None	Sludge filtered and sent to sludge disposal on agricultural lands.	Drainage districts adjacent to land treatment sites were applied to the land following storage.	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Kent-Ravenna	Secondary treatment at Ravenna prior to land application. (1 plant)	None	Physical-Chemical plant located at Kent. (1 plant)	Incineration at Kent. Ravenna sludge disposal on agricultural lands.	None	Available capacity in the plants were used to treat drainage districts during off peak hours.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.

TABLE B2 (CONT'D.)

Area	MUNICIPAL WASTEWATER (31 Plants)			STORMWATER		
	Land Based Treatment In Basin	Out of Basin	Water Based Treatment (1 Plant)	Sludge Handling	Land Based Treatment	Water Based Treatment
Akron	None	None	Advanced biological plant. (1 Plant)	Sludge application to strip mines.	None	Available capacity in the plant was used to treat some of drainage districts during off peak hours. Individual stormwater plants were used to treat the remaining districts.
Southerly	None	None	Advanced biological plant at Southerly. (1 Plant)	Sludge application to strip mines.	None	Available capacity in the plant was used to treat some of drainage districts during off peak hours. Individual stormwater plants were used to treat the remaining districts.
Westerly	None	None	Physical chemical plant. (1 Plant)	Incineration	None	Sludge from the concrete basins was taken to the municipal plant via sewers. Sludge from earth basins will be periodically removed for recycle or landfill.
Easterly	None	None	Advanced biological plant. (1 Plant)	Sludge application to strip mines.	None	Available capacity in the plant was used to treat drainage districts during off peak hours.
Lake Erie	None	None	Physical chemical plant at Rocky River. Advanced biological plant at Euclid. (2 Plants)	Digested sludge from Rocky River disposed of on agricultural lands. Euclid sludge applied to strip mines.	None	Sludge from concrete basins taken to the municipal plant.

### 3. PLAN C

Plan C contains the most land treatment. A large tunnel conveys raw wastewater to the western lands where it receives secondary treatment in aerated lagoons and is applied to the land. Table B3 describes the ultimate plan for the generalized areas. Within the basin most of secondary plants are replaced by aerated lagoons. Akron remains as the only advanced biological plant and the only plant discharging to the Lake or receiving streams within the study area.

The tunnel is scheduled for construction in the 1980-1990 decade. The initial section within the basin would be constructed first and would act as a storage and conveyance facility for the combined sewer area. The section from the basin to the western lands would be available by 1985 and after that time all of the plants would be phased out rather than expanded to advanced treatment plants. The sludge that was generated at these plants would then be removed at the western lands aerated lagoon and applied to the land in that area. No sludge is taken to the strip mine area.

The upper Rocky, upper Chagrin and upper Cuyahoga are similar under Plans B and C. In the Kent-Ravenna area, both plants would be aerated lagoons with land treatment.

TABLE B3  
PLAN C - DESCRIPTION

PLAN C (Old Plan 2)

Area	MUNICIPAL WASTEWATER (12 Plants)				STORMWATER		
	Land Based Treatment In Basin	Out of Basin	Water Based Treatment	Sludge Handling	Land Based Treatment	Water Based Treatment	Sludge Handling
Upper Rocky	Regionalization limited. Plants provide secondary treatment prior to land application. (6 Plants)	None	None	Sludge disposal on agricultural lands in basin.	Drainage in districts adjacent to land treatment sites was applied to the land following storage	Available capacity in the livestock plant was used to treat drainage districts during off peak hours. Individual stormwater treatment plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Lower Rocky	None	Lakewood and North Olmsted plants discharge to tunnel to Western Ohio lands. (2 Plants)	None	Sludge disposal on agricultural lands in Western Ohio.	Adjacent drainage districts discharge to tunnel to Western Ohio lands.	Available capacity in the plants were used to treat off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Upper Chagrin	Regionalization limited. Plants provide secondary treatment prior to land application. (6 Plants)	None	None	Sludge disposal on agricultural lands in basin.	Drainage districts adjacent to land treatment sites were applied to the land following storage	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Lower Chagrin	None	Willoughby-Eastlake discharges to tunnel to Western Ohio lands. (1 Plant)	None	Sludge disposal on agricultural lands in Western Ohio.	Adjacent drainage districts discharge to tunnel to Western Ohio lands.	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Upper Cuyahoga	Regionalization limited. Plants provide secondary treatment prior to land application. (9 Plants)	None	None	Sludge disposal on agricultural lands in basin.	Drainage districts adjacent to land treatment sites were applied to the land following storage.	Available capacity in the plants were used to treat drainage districts during off peak hours. Individual stormwater plants were used for the remaining drainage districts.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.
Kent-Ravenna	Plants at Kent and Ravenna provide secondary treatment prior to land application. (2 Plants)	None	None	Sludge disposal on agricultural lands in basin.	None	Available capacity in the plants were used to treat drainage districts during off peak hours.	Only earth basins were used in this area. Therefore sludge will be periodically removed for recycle or landfill.

TABLE 33 (CONT'D.)

Area	MUNICIPAL WASTEWATER (32 Plants)				STORMWATER		
	In Basin	Land Based Treatment Out of Basin	Water Based Treatment	Sludge Handling	Land Based Treatment	Water Based Treatment	Sludge Handling
Akron	None	None	Advanced biological plant. (1 Plant)	Sludge disposal on agricultural lands in basin.	None	Available capacity in the plant was used to treat some of drainage districts during off peak hours. Individual stormwater plants were used to treat the remaining districts.	Sludge from the concrete basins was taken to the municipal plant via sewers. Sludge from earth basins will be periodically removed for recycle or landfill.
Southerly	None	Regionalization limited as compared to Plan A. Discharge to tunnel to Western Ohio lands. (1 Plant)	None	Sludge disposal on agricultural lands in Western Ohio.	Adjacent drainage districts discharge to tunnel to Western Ohio lands.	Available capacity in the plant was used to treat some of drainage districts during off peak hours. Individual stormwater plants were used to treat the remaining districts.	Sludge from the concrete basins was taken to the municipal plant via sewers. Sludge from earth basins will be periodically removed for recycle or landfill.
Westerly	None	Discharge to tunnel to Western Ohio lands. (1 Plant)	None	Sludge disposal on agricultural lands in Western Ohio.	Adjacent drainage districts discharge to tunnel in Western Ohio lands.	Available capacity in the plant was used to treat drainage districts during off peak hours.	Sludge from concrete basins taken to the municipal plant.
Easterly	None	Discharge to tunnel to Western Ohio lands. (1 Plant)	None	Sludge disposal on agricultural lands in Western Ohio.	Adjacent drainage districts discharge to tunnel to Western Ohio lands.	Available capacity in the plant was used to treat drainage districts during off peak hours.	Sludge from concrete basins taken to the municipal plant.
Lake Erie	None	Euclid and Rocky River plants discharge to tunnel to Western Ohio lands. (2 Plants)	None	Sludge disposal on agricultural lands in Western Ohio.	Adjacent drainage districts discharge to tunnel to Western Ohio lands.	Available capacity in the plant was used to treat drainage districts during off peak hours.	Sludge from earth basins will be periodically removed for recycle or landfill.

## C - COST OF SELECTED PLANS

A detailed description of the three selected plans is presented in the Plan Formulators Phase report. Cost of these plans have been estimated using the economic technique as described in Section A-4 of this report.

Due to the complexity of the costing technique and the quantity of data to be generated, a computer program was used for the computation and presentation of data. The cost presentation format is similar to that described in Section A-4 of this report which includes all component costs for capital expenditures and operation and maintenance. In addition, all pertinent information, including population projections, industrial and domestic flows, one year storm runoff and annual runoff, is shown.

It should be emphasized that the costs presented in the following sections are not the total plan costs in that they only represent the cost estimation of the three plans as related to the Havens and Emerson, Ltd. portion of the study. All costs associated with land treatment and the total plan cost summary are presented in the Land Contractor's Phase III report. Unit costs and composite costs for the various types of treatment used in the three plans are discussed in detail in the Phase II report.

All plans include costs for interim plants. Interim plants include those facilities which are phased out during the study period in favor of another regional plant. In particular, the interim plants include all those affected by the construction of the future Southwest Interceptor and the Cuyahoga Valley Interceptor.

Land cost were computed for those plants where the operating agency did not own sufficient land for future expansions.

## 1. COST OF MUNICIPAL PLANTS

1.1 PLAN A. Plan A is basically a modification of present planning to higher effluent levels. All municipal plants are developed as either advanced biological plants or physical-chemical plants. Table C1 summarizes the total present worth for the municipal plants. Table C2 summarizes the total annual costs for the municipal plants. These costs were taken from the computer sheets which are displayed in Appendix A of this Technical Appendix.

1.2 PLAN B. Plan B is a combination of land-based and water-based treatment. Basically, only the smaller municipal plants in the upper basin regions were taken to land-treatment. At these plants secondary treatment is provided prior to the land application. Table C3 summarizes the total present worth for the municipal plants. Table C4 summarizes the total annual costs for the municipal plants. These costs were taken from the computer sheets which are displayed in Appendix B of this Technical Appendix.

1.3 PLAN C. Plan C ultimately provides for land-based treatment for all municipalities with the exception of Akron. The land-based treatment includes in-basin application for the upper basin municipalities and out-of-basin application for the shoreline, and lower basin municipalities. The out-of-basin application is via a tunnel to Western Ohio. Table C5 summarizes the total present worth for the municipal plants. Table C6 summarizes the total annual costs for the municipal plants. These costs were taken from the computer sheets for each plant which are displayed in Appendix C of this Technical Appendix.

TABLE C1  
PLAN A - MUNICIPAL  
TOTAL PRESENT WORTH  
(\$1,000)

<u>Plant</u>	<u>Capital</u>	<u>O&amp;M</u>	<u>Land</u>	<u>Total</u>
Liverpool	\$ 23,497	\$ 12,306	\$ 0	\$ 35,804
Southerly	152,777	171,011	2,780	326,568
Rocky River	3,891	15,349	0	19,241
Lakewood	12,285	22,750	0	35,036
Aurora Central	3,746	2,109	30	5,885
McFarland Creek	7,004	2,768	0	9,773
Fowlers Mill	2,887	1,895	20	4,802
Newbury Twp.	1,896	1,489	15	3,400
Chagrin Falls	3,876	3,342	179	7,398
Fairmount Road	3,955	2,193	0	6,148
Chagrin E. Branch	3,223	2,110	20	5,353
Willoughby-Eastlake	10,533	12,837	0	23,371
Butternut Creek	1,960	1,198	12	3,170
East Claridon	667	510	5	1,183
Burton	1,311	1,055	9	2,376
Middlefield	2,984	2,701	27	5,712
Auburn Twp.	1,185	929	8	2,122
Troy Twp.	592	496	5	1,093
Mantua	1,087	1,121	0	2,209
Akron	52,028	96,993	118	149,140
Kent	12,916	15,299	520	28,735
Ravenna	8,950	7,127	0	16,077
Randolph Twp.	1,070	963	8	2,042
Easterly	65,633	155,966	0	221,600
Euclid	15,342	25,232	360	40,934
Westerly	43,942	44,231	0	88,173
Chardon	234	21	0	256
Interim Plants	11,422	24,539	33	36,001
Totals	\$450,893	\$628,540	\$4,149	\$1,083,602

TABLE C2  
PLAN A - MUNICIPAL  
TOTAL ANNUAL COST  
(\$1000/YR)

Plant	1972	1975	1980	1985	1990	2000	2010	2020
Liverpool	\$ 298	\$ 2,025	\$ 2,200	\$ 2,988	\$ 4,128	\$ 4,441	\$ 4,840	\$ 5,309
Southerly	7,301	15,303	18,150	28,237	34,817	45,439	47,148	47,954
Rocky River	638	816	1,157	1,365	1,851	2,716	2,986	3,199
Lakewood	1,388	2,109	2,144	2,885	3,329	4,046	4,149	4,253
Aurora Central	32	201	303	447	820	886	979	1,088
McFarland Creek	23	546	576	771	1,174	1,287	1,414	1,527
Fowlers Mill	66	258	275	359	559	607	679	759
Newbury Twp.	52	146	159	228	453	494	538	616
Chagrin Falls	107	339	399	567	857	985	1,073	1,151
Fairmount Road	9	259	292	455	834	925	1,028	1,121
Chagrin E. Branch	76	271	331	428	625	671	731	799
Willoughby-Eastlake	264	580	1,394	2,064	2,742	3,632	4,055	4,415
Burton	28	93	133	155	313	339	375	421
Middlefield	110	288	319	441	675	726	811	889
Auburn Twp.	26	81	115	159	268	299	334	367
Troy Twp.	14	43	49	72	142	160	180	200
Mantua	45	107	113	164	265	289	325	351
Akron	4,688	6,423	6,947	14,988	16,964	18,476	20,094	21,915
Kent	487	1,681	1,884	2,154	2,864	3,213	3,596	4,212
Ravenna	210	749	816	1,140	1,933	2,385	2,618	2,814
Randolph	32	105	113	132	250	272	306	329
Easterly	8,253	11,101	11,709	17,354	20,738	29,350	29,888	30,606
Euclid	1,146	1,928	2,109	2,999	4,416	5,760	6,223	6,564
Westerly	3,014	6,497	6,548	6,655	8,247	8,376	8,504	8,708
East Claridon	12	148	186	243	451	454	472	492
Butternut Creek	37	145	191	244	390	423	471	529
Chardon	0	0	31	31	31	32	32	32
Interim Plants	1,891	3,710	4,321	3,504	3,830	1,196	0	0
Total	\$30,245	\$55,952	\$62,964	\$91,229	\$113,946	\$137,887	\$143,849	\$150,620

TABLE C3  
PLAN B - MUNICIPAL  
TOTAL PRESENT WORTH  
(\$1,000)

Plant	Capital	O&M	Land	Total
Liverpool	\$ 2,036	\$ 279	\$ 0	\$ 2,315
Southerly	152,469	169,006	2,780	324,255
Rocky River	3,891	15,349	0	19,241
Lakewood	12,285	22,750	0	35,036
Aurora Central	898	157	30	1,085
Fowlers Mill	892	192	20	1,041
Newbury Twp.	229	127	15	371
Chagrin Falls	3,511	520	0	4,031
Fairmount Road	772	113	0	885
Chagrin E. Branch	1,011	224	20	1,255
Willoughby-Eastlake	10,533	12,837	0	23,371
Butternut Creek	682	139	12	833
East Claridon	113	46	5	164
Burton	1,187	339	36	1,562
Auburn Twp.	214	84	8	306
Troy Twp.	15	44	5	64
Mantua	21	101	0	122
Akron	52,028	96,993	118	149,140
New Kent	12,916	15,299	520	28,735
Randolph Twp.	191	91	8	290
Easterly	65,633	155,966	0	221,600
Euclid	15,342	25,232	360	40,934
Westerly	43,942	44,231	0	88,173
Upper E. Branch	22	47	0	69
Hinckley	2,330	222	0	2,552
Mallet Creek	165	61	0	226
Ravenna	1,307	490	0	1,797
Medina Co.	1,145	211	0	1,356
New Medina	1,252	446	0	1,698
Shalersboro	353	85	33	472
Chardon	6	6	0	12
Interim Plants	10,565	23,363	0	33,928
Total	\$397,891	\$585,050	\$3,970	\$986,919

TABLE C4  
PLAN B - MUNICIPAL  
TOTAL ANNUAL COST  
(\$1000/YR)

Plant	1972	1975	1980	1985	1990	2000	2010	2020
Liverpool	\$ 53	\$ 195	\$ 197	\$ 198	\$ 199	\$ 200	\$ 202	\$ 207
Southerly	7,301	15,270	18,084	28,085	34,478	45,051	46,687	47,436
Rocky River	638	816	1,157	1,365	1,851	2,716	2,986	3,199
Lakewood	1,388	2,109	2,144	2,885	3,329	4,046	4,149	4,253
Aurora Central	32	5	80	81	166	168	170	172
Fowlers Mill	66	81	81	82	82	83	85	87
Newbury Twp.	52	4	5	5	61	62	64	66
Chagrin Falls	130	310	337	339	341	400	403	405
Fairmount Road	9	61	61	63	103	105	107	109
Chagrin E. Branch	76	69	111	112	112	113	115	116
Willoughby-Eastlake	264	580	1,394	2,064	2,742	3,632	4,055	4,415
Butternut Creek	37	41	77	78	78	79	81	83
East Claridon	12	11	12	12	12	13	14	15
Burton	138	83	122	136	142	143	145	148
Auburn Twp.	26	3	30	30	30	31	33	34
Troy Twp.	14	2	2	3	3	4	5	6
Mantua	45	4	4	5	5	6	7	8
Akron	4,688	6,423	6,947	14,988	16,964	18,476	20,094	21,915
New Kent	487	1,681	1,884	2,154	2,864	3,218	3,596	4,212
Randolph Twp.	32	20	20	20	21	22	23	24
Easterly	8,979	11,872	12,523	17,775	20,741	29,347	29,885	30,602
Euclid	1,146	1,928	2,109	2,999	4,416	5,760	6,223	6,564
Westerly	3,014	6,497	6,548	6,655	8,247	8,376	8,504	8,708
Upper E. Branch	0	3	4	5	6	7	9	10
Hinckley	0	223	224	225	226	227	228	229
Mallet Creek	13	17	17	18	18	19	20	21
Ravenna	210	129	130	132	134	141	145	148
Medina Co.	53	111	112	113	114	115	118	122
New Medina	179	125	127	128	130	133	137	139
Shalersboro	2	6	49	50	51	52	53	54
Chardon	0	0	1	1	1	1	2	2
Interim Plants	1,813	3,489	4,409	3,321	3,634	1,106	0	0
Total	\$30,897	\$52,168	\$58,642	\$84,127	\$101,301	\$123,852	\$128,346	\$133,456

TABLE C5  
PLAN C - MUNICIPAL  
TOTAL PRESENT WORTH  
(\$1,000)

Plant	Capital	O&M	Land	Total
Liverpool	\$ 2,036	\$ 279	\$ 0	\$ 2,315
Southerly	92,403	94,313	1,000	187,716
Rocky River	1,170	8,561	0	9,732
Lakewood	7,060	13,434	0	20,494
Aurora Central	898	157	30	1,085
Fowlers Mill	829	192	20	1,041
Newbury Twp.	229	127	15	371
Chagrin Falls	3,511	520	0	4,031
Fairmount Road	772	113	0	885
Chagrin E. Branch	1,011	224	20	1,255
Willoughby-Eastlake	5,892	5,476	0	11,368
Butternut Creek	682	139	12	833
East Claridon	113	46	5	164
Burton	1,187	339	36	1,562
Auburn Twp.	214	84	8	306
Troy Twp.	15	44	5	64
Mantua	21	101	0	122
Akron	52,028	96,993	118	149,140
New Kent	4,054	1,247	520	5,821
Randolph Twp.	191	91	8	290
Easterly	23,687	102,969	0	126,656
Euclid	6,370	13,510	360	20,240
Westerly	32,700	30,279	0	62,979
Upper E. Branch	22	47	0	69
Hinckley	2,330	222	0	2,552
Mallet Creek	165	61	0	226
Ravenna	1,307	490	0	1,797
Medina Co.	1,145	211	0	1,356
New Medina	1,252	446	0	1,698
Shalersboro	353	85	33	472
North Olmsted	9,933	10,808	0	20,741
Chardon	6	6	0	12
Interim Plants	9,178	15,717	0	23,897
Total	\$262,764	\$397,331	\$2,190	\$661,290

TABLE C6

PLAN C - MUNICIPAL  
TOTAL ANNUAL COST  
(\$1000/YR)

Plant	1972	1975	1980	1985	1990	2000	2010	2020
Liverpool	\$ 1	\$ 195	\$ 197	\$ 198	\$ 199	\$ 200	\$ 200	\$ 202
Southerly	7,301	14,908	17,359	16,649	15,927	16,616	10,376	4,904
Rocky River	638	816	1,157	1,027	826	164	164	74
Lakewood	1,388	2,109	2,145	1,848	1,471	720	549	38
Aurora Central	32	5	80	81	166	168	170	172
Fowlers Mill	66	81	81	82	82	83	85	87
Newbury Twp.	52	4	5	5	61	62	64	66
Chagrin Falls	130	310	337	339	341	400	403	405
Fairmount Road	9	61	61	63	103	105	107	109
Chagrin E. Branch	76	69	111	112	112	113	115	116
Willoughby-Eastlake	264	581	1,286	1,258	1,319	840	847	853
Butternut Creek	37	41	77	78	78	79	81	83
East Claridon	12	11	12	12	12	13	14	15
Burton	138	83	122	136	142	143	145	148
Auburn Twp.	26	3	30	30	30	31	33	34
Troy Twp.	14	2	2	3	3	4	5	6
Mantua	45	4	4	5	5	6	7	8
Akron	4,688	6,423	6,947	14,988	16,964	18,476	20,094	21,915
New Kent	487	400	404	409	414	422	430	437
Randolph Twp.	32	20	20	20	21	22	23	24
Easterly	8,979	11,812	12,464	10,622	7,982	8,359	1,318	365
Euclid	1,146	1,945	2,126	1,939	1,591	670	457	68
Westerly	3,014	6,498	6,549	5,633	4,648	4,695	78	82
Upper E. Branch	0	3	4	5	6	7	9	10
Hinckley	0	223	224	225	226	227	228	229
Mallet Creek	13	17	17	18	18	19	20	21
Ravenna	210	129	130	132	134	141	145	148
Medina Co.	53	111	112	113	114	115	118	122
New Medina	179	125	127	128	130	133	137	139
Shalersboro	2	6	49	50	51	52	53	54
North Olmsted	377	1,114	2,582	2,441	2,180	1,284	1,293	1,049
Chardon	0	0	1	1	1	1	2	2
Interim Plants	1,334	2,704	3,104	2,241	2,419	961	0	0
Total	\$30,743	\$50,813	\$57,926	\$60,891	\$57,776	\$55,331	\$37,770	\$31,985

## 2. STORMWATER PLANTS

2.1 PLAN A. In Plan A, stormwater is treated in individual stormwater plants and at the municipal plants. There is no land treatment of stormwater in Plan A. The treatment arrangement was optimized to take full economic advantage of available capacity in the municipal plants as well as regionalization of individual stormwater plants, where applicable. Table C7 summarizes the total present worth for the stormwater plants. Table C8 summarizes the total annual costs for the stormwater plants. These costs were taken from the computer sheets for each drainage district, which are displayed in Appendix A of this Technical Appendix.

2.2 PLAN B. In Plan B, stormwater is treated in individual stormwater plants, at the municipal plants, and at in-basin land treatment sites. The major difference between the treatment arrangement of Plan A and Plan B is the addition of land treatment of stormwater in the upper basin areas. The stormwater districts were developed on the basis of their proximity to land treatment areas. Table C9 summarizes the total present worth for the stormwater plants. Table C10 summarizes the total annual costs for the stormwater plants. These costs were taken from the computer sheets for each drainage district which are displayed in Appendix B of this Technical Appendix.

2.3 PLAN C. Plan C ultimately provides for land-based treatment for most of the stormwater districts in the study area. Stormwater is treated at some individual stormwater plants and at municipal plants, however, where land application was not feasible. As in Plan B, in-basin land treatment of stormwater was provided in the upper basin areas. Out-of-basin land treatment of stormwater was provided for the Lake Erie and lower basin drainage districts. These were discharged to the tunnel for treatment in

Western Ohio. Table C11 summarizes the total present worth for the storm-water plants. Table C12 summarizes the total annual costs for the storm-water plants. These costs were taken from the computer sheets for each drainage district which are displayed in Appendix C of this Technical Appendix.

TABLE C7  
PLAN A  
TOTAL PRESENT WORTH  
STORMWATER TREATMENT  
(\$1000)

	<u>Capital</u>	<u>O&amp;M</u>	<u>Land</u>	<u>Total</u>
Chagrin	19,141	8,174	947	28,260
Rocky	55,905	14,265	533	70,712
Lake Erie	246,834	43,956	356	291,510
Cuyahoga	<u>364,434</u>	<u>68,705</u>	<u>5,540</u>	<u>438,124</u>
TOTAL	686,314	135,100	7,376	828,606

TABLE C8  
PLAN A  
TOTAL ANNUAL COST  
STORMWATER TREATMENT  
(\$1000/YEAR)

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
Chagrin	0	754	1,439	4,360	7,660	7,973	8,283
Rocky	65	4,410	6,054	11,668	13,956	14,374	14,734
Lake Erie	11,822	25,957	29,848	35,955	36,232	36,467	36,611
Cuyahoga	<u>15,356</u>	<u>29,155</u>	<u>45,034</u>	<u>57,187</u>	<u>64,587</u>	<u>65,833</u>	<u>66,492</u>
TOTAL	27,243	60,276	82,375	109,170	122,435	124,647	126,120

TABLE C9  
PLAN B  
TOTAL PRESENT WORTH  
STORMWATER TREATMENT  
(\$1000)

	<u>Capital</u>	<u>O&amp;M</u>	<u>Land</u>	<u>Total</u>
Chagrin	14,524	6,234	947	21,720
Rocky	47,477	12,773	548	60,812
Lake Erie	246,834	43,956	356	291,510
Cuyahoga	<u>336,031</u>	<u>64,414</u>	<u>5,645</u>	<u>405,758</u>
TOTAL	644,866	127,377	7,496	779,800

TABLE C10  
PLAN B  
TOTAL ANNUAL COST  
STORMWATER TREATMENT  
(\$1000/YEAR)

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
Chagrin	0	720	1,381	3,567	5,105	5,270	5,438
Rocky	68	4,259	5,300	9,804	11,185	11,439	11,623
Lake Erie	11,822	25,957	29,848	35,955	36,232	36,467	36,611
Cuyahoga	<u>15,356</u>	<u>27,985</u>	<u>41,780</u>	<u>51,737</u>	<u>57,054</u>	<u>58,144</u>	<u>58,631</u>
TOTAL	27,246	58,921	78,309	101,063	109,576	111,320	112,303

TABLE C11  
PLAN C  
TOTAL PRESENT WORTH  
STORMWATER TREATMENT  
(\$1000)

	<u>Capital</u>	<u>O&amp;M</u>	<u>Land</u>	<u>Total</u>
Chagrin	14,118	3,956	947	19,032
Rocky	34,385	9,767	548	44,715
Lake Erie	96,692	25,581	356	122,635
Cuyahoga	<u>256,442</u>	<u>49,815</u>	<u>5,705</u>	<u>311,991</u>
TOTAL	401,637	89,119	7,556	498,373

TABLE C12  
PLAN C  
TOTAL ANNUAL COST  
STORMWATER TREATMENT  
(\$1000/YEAR)

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
Chagrin	0	679	1,191	3,214	4,497	4,574	4,661
Rocky	64	2,412	3,361	7,740	8,980	9,205	9,389
Lake Erie	6,416	13,740	13,625	12,849	11,898	11,944	11,980
Cuyahoga	<u>11,732</u>	<u>24,102</u>	<u>30,886</u>	<u>38,793</u>	<u>43,837</u>	<u>43,707</u>	<u>44,168</u>
TOTAL	18,212	40,933	49,063	62,596	69,212	69,430	70,198

### 3. COST SUMMARY - MUNICIPAL AND STORMWATER

Table C13 displays the total present worth for Plans A, B, and C for both municipal and stormwater facilities. As mentioned previously, these are not the total plan costs which is the reason for the apparent low cost of Plan C. The Plan C cost presented do not include costs associated with land treatment and the cost of the tunnel to Western Ohio. Total cost summaries can be found in the Plan Formulation report.

Table C14 displays the total annual costs for Plans A, B, and C that are associated with the cost in Table C13.

TABLE C13  
SUMMARY  
TOTAL PRESENT WORTH  
(\$1000)

	<u>Capital</u>	<u>O&amp;M</u>	<u>Land</u>	<u>Total</u>
<u>Plan A</u>				
Municipal	450,893	628,540	4,149	1,083,602
Stormwater	686,314	135,100	7,376	828,606
Total	1,137,207	763,640	11,525	1,912,208
 <u>Plan B</u>				
Municipal	397,891	585,050	3,970	986,919
Stormwater	644,866	127,377	7,496	779,800
Total	1,042,757	712,427	11,466	1,766,719
 <u>Plan C</u>				
Municipal	262,764	397,331	2,190	661,290
Stormwater	401,637	89,119	7,556	498,373
Total	664,401	486,450	9,746	1,159,663

TABLE C14  
SUMMARY  
TOTAL ANNUAL COST  
(\$1000/YEAR)

	<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<u>Plan A</u>								
Municipal	30,245	55,952	62,964	91,229	113,946	137,887	143,849	150,620
Stormwater	0	27,243	60,276	82,375	109,170	122,435	124,647	126,120
Total	30,245	83,195	123,240	173,604	223,116	260,322	268,496	276,740

<u>Plan B</u>								
Municipal	30,897	52,168	58,642	84,127	101,301	123,852	128,346	133,456
Stormwater	0	27,246	58,921	78,309	101,063	109,576	111,320	112,303
Total	30,897	79,414	117,563	162,436	202,364	233,428	239,666	245,759

<u>Plan C</u>								
Municipal	30,743	50,813	57,926	60,891	57,776	55,331	37,770	31,985
Stormwater	0	18,212	40,933	49,063	62,596	69,212	69,430	70,198
Total	30,743	69,025	98,859	109,954	120,372	124,543	107,200	102,183

#### D - EARLY ACTION PROGRAMS

Early action demonstration and monitoring programs are recommended to provide guidance for future decisions and reliable criteria for design. The demonstration projects would be constructed and placed in operation as soon as possible to provide data on cost and effectiveness. These projects should be arranged to produce information by the beginning of the first phase of construction. The monitoring program is recommended to provide baseline conditions and to record changes as additional treatment is provided.

## 1. DEMONSTRATION PROJECTS

Several programs and demonstration projects which appear to be desirable have resulted from this study. Many of unit processes required to meet the stringent effluent criteria herein are untried on a scale of this magnitude, and may have residual effects that are unknown. It is important to make clear that it is the intent of this plan to demonstrate the effectiveness and monitor the environmental change both beneficial and detrimental of these processes.

Because of the uncertainties of the location and scope of work, costs have not been assigned to the demonstration projects.

- (1) Treatment of Urban Stormwater Runoff from a Separate Sewered Densely Populated Area of Mixed Residential, Industrial and Commercial Developments.

This demonstration project would be a stormwater treatment plant in a densely populated area. Storage would be provided in concrete basins and would be optimized with the treatment plant capacity to result in the lowest total annual cost. Monitoring would be done on both the influent and effluent. Rainfall and subsequent runoff would be also measured. The treatment scheme would be planned to treat to both Level 1 and Level 2.

- (2) Treatment of Urban Stormwater Runoff from a Separate Sewered Moderately Populated Area not in a Metropolitan Urban Environment.

This demonstration project would be a stormwater treatment plant in a suburban residential area such as a smaller outlying city in rural surroundings. Storage would be provided in earth basins. Treatment capacity would be provided to empty the basin in about 30 days. The monitoring of both quality and quantity would be similar to the demonstration project in densely populated areas. The treatment would be arranged such that the effluent quality would meet Level 1 or Level 2 quality depending upon the process selected for demonstration.

(3) Physical-Chemical Treatment for Municipal Wastewater.

This demonstration project would be conducted at a 5-10 mgd plant. The unit processes would be capable of treating to a Level 2 effluent quality. Cost of operation will be monitored closely with efficiency to determine the relationships. Also, side stream studies could be made to determine response to highly varying flow rates.

The proposed Westerly plant unit processes may be used for investigating the ability of these processes to treat a mixed domestic-industrial waste. Some side stream modifications would be required to meet the level criteria.

(4) Advanced Biological Plant.

A plant should be constructed using the advanced biological scheme unit processes for Levels 1 and 2 treatment. The plant influent and effluent will be monitored as will the river above and below the plant effluent. The river should be monitored both for chemical and biological quality to assess the benefits of higher degrees of treatment. The results of this demonstration should clearly exhibit the cost and benefit of higher degrees of treatment.

(5) Field Demonstration of Runoff Reduction by Urban Drainage Management.

Under this demonstration project, a representative development project would be modified to provide storm drains, on-site storage, parking lot storage, roof-top storage, and site work, all designed for maximum infiltration. The purpose is to demonstrate the techniques that can be used to reduce runoff. Sedimentation control practices could also be demonstrated.

(6) Sludge Handling.

Several demonstration projects should be undertaken concerning various ways sludge can be handled. A project demonstrating the application of sludge to the land should be carried out on agricultural land, strip mined areas and in a sanitary landfill. Leachate and surface runoff should both be monitored for metals, salts, nutrients, and viruses. Growth characteristics of crops on the conditioned land should be compared to typical local soils that have not been conditioned. Techniques of applying the sludge should also be investigated and cost computed, including problems posed by wintertime conditions.

(7) Land Treatment.

Several demonstration projects are desirable on land treatment. These are: a land treatment demonstration in the upper Cuyahoga basin for a small city; a larger project using the Mahoning-Ellsworth soils; and a project in the Western area site. Both municipal and domestic wastewater should be used. Details of these projects are presented in the land treatment report.

## 2. MONITORING PROGRAM

A program is recommended for monitoring the quality and quantity of the waters of the Three Rivers area. The purpose of the monitoring program is to record the change in quality and quantity of the river as additional treatment is provided. These data can be used to assess the benefit and compare it to the cost for future decision making.

In order to determine water quality conditions for concurrence or non-concurrence with standards, measurements of the critical parameters must be made. For the existing standards, these critical parameters are dissolved oxygen, temperature, pH and dissolved solids. Continuous recording analyzers are available for D.O., temperatures, specific conductivity, and pH. Dissolved solids can be estimated by specific conductance measurements. Flow is an additional measurement which is necessary for computing flowing loads and determining the occasions of critical low flow. Table D1 and D2 list the continuous and periodic observation sites which would be required for adequate coverage of the entire study area. The column marked adequate control refers to stream channel stability for flow gaging. Of course, the more stable the cross section, the less the rating curve would change, meaning less frequent discharge measurements required and a lower operational and maintenance cost for the gaging station.

Table D2 lists those analyses which should be taken intermittently, since, because of present technology, they cannot be done continuously. Generally, these parameters would not have to be measured on a year-round basis, and some of the determinations might be done by a local wastewater treatment plant.

Table D3 gives an estimate of cost for this program as outlined in Tables D1 and D2.

Table D4 lists the minimum measurements suggested for adequate knowledge of the character of different wastewaters inputs. Table D5 lists additional analysis that would be helpful in a further definition of the pollutant load.

A central agency should be responsible for collecting and evaluating this data. Periodic summaries on the water quality should be distributed to those people responsible for the operation of the plants and to those agencies responsible for the enforcement of the water quality or effluent standards.

TABLE D1  
WATER QUALITY MONITORING PROGRAM  
CONTINUOUS OBSERVATION SITES

Cuyahoga River Location	D.O.	TEMP.	pH	Spec. Cond.	Flow	Adequate Control
Hiram Rapids	X	X	X	X	X	No.
Upstream of Lake Rockwell	X	X	X	X	X	No
Munroe Falls - Downstream of Dam	X	X	X	X	X	Yes
Ohio Edison Pool		X				Yes
Portage Path	X	X	X	X	X	No
Near Furnace Run @ Sag	X	X	X	X	X	No
Ohio Canal Diversion River Weir					X	Yes
Independence	X	X	X	X	X	No
Head of Navigation Channel	X	X	X	X		
Lorain Avenue Bridge	X	X	X	X		
<u>Little Cuyahoga River</u>						
Upstream of Confluence with Cuyahoga River	X	X	X	X	X	No
<u>Chagrin</u>						
Downstream of Aurora Branch	X	X	X	X	X	No

TABLE D1 (CONT'D.)  
WATER QUALITY MONITORING PROGRAM  
CONTINUOUS OBSERVATION SITES

<u>Chagrin Cont'd.</u>	<u>D.O.</u>	<u>TEMP.</u>	<u>pH</u>	<u>Spec. Cond.</u>	<u>Flow</u>	<u>Adequate Control</u>
Downstream of East Branch @ Willoughby Gage	X	X	X	X	X	No
East Branch near Mouth	X	X	X	X	X	No
<u>Rocky River</u>						
Downstream of Medina S.D. 100 Effluent @ Columbia Station S.R. 82	X	X	X	X	X	No
Berea Gage @ Cedar Point	X	X			X	No
East Branch near Mouth	X	X	X	X	X	No
Mouth and Boat Ramp Area	X	X	X	X	X	Yes

TABLE D2  
WATER QUALITY MONITORING PROGRAM  
PERIODIC OBSERVATION SITES

Cuyahoga River Location	BOD	COD	Solids		Total Coliform	Fecal Coliform	Fecal Strep.	Sedi- ment
			Diss.	Susp.				
Hiram Rapids	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Weekly
Upstream of Lake Rockwell	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Weekly
Munroe Falls - Downstream of Dam	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Monthly
Portage Path	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Monthly	Daily
Near Furnace Run @ Sag	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Monthly	-
Ohio Canal Diversion - River Weir	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	-
Independence	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Daily
Head of Navigation Channel	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	-
Lorain Avenue Bridge	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	-
<u>Little Cuyahoga River</u>								
Upstream of Confluence with Cuyahoga River	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	-
<u>Chagrin</u>								
Downstream of Aurora Branch	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
Downstream of East Branch @ Willoughby Gage	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
East Branch near Mouth	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly

TABLE D2 (CONT'D.)  
WATER QUALITY MONITORING PROGRAM  
PERIODIC OBSERVATION SITES

Rocky River	BOD	COD	Solids		Total Coliform	Fecal Coliform	Fecal Strep.	Sedi-ment
			Diss.	Susp.				
Downstream of Medina & S.D. 100								
Effluent @ Columbia Station S.R. 82	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	-
Berea Gage @ Cedar Point	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
East Branch near Mouth	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
Mouth & Boat Ramp Area	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Monthly

TABLE D3  
ESTIMATED COST OF MONITORING PROGRAM

Capital cost of constructing gage and monitoring house Plus installing low flow controls.	\$500,000
Annual Cost at 7% for 10 years	71,200
Annual O & M of station and rating gages	50,000
Annual cost of periodic sampling and analysis	61,000
Administrative cost	<u>30,000</u>
Total Annual Cost	\$712,200

TABLE D4  
SUGGESTED MINIMUM MEASUREMENT OF WASTEWATER INPUTS\*1

Source	BOD	COD	pH	Temp.	Susp. Solids	Spec. Cond.	Total Colif. Fecal Colif.	DO	NH4		P
									Organic N	NO <sub>3</sub>	
Domestic Waste Water	X	X	X	X	X	X	X	X	X	X	X
Industrial Process Water*2	X	X	X	X	X	X	X	X			
Industrial Cooling Water		X		X							
Storm Water Discharges	X				X		X	X	X		X
Combined Sewer Overflows Discharge					X		X	X	X		X

\*1 Frequency would depend on size of plant or operation of process.

\*2 An initial list for various industries should be prepared.

TABLE D5  
ADDITIONAL MEASUREMENTS OF WASTEWATER INPUTS

	Soluble BOD	Soluble COD	Soluble P	Soluble Nitrogens	Heavy Metals	Dissolved Solids
Domestic Wastewater	X	X	X	X	X	X
Storm Water Discharge		X			X	
Combined Sewer Overflow Discharge		X			X	

## E - RELATED ENVIRONMENTAL EFFECTS

The various methods of wastewater treatment and solids disposal involve different effects on the environment, and different environmental trade-offs. It is the task of the Evaluation Consultant to evaluate the environmental impacts of each plan, but in this section, some of the basic information necessary for this assessment is presented.

## 1. CHEMICAL REQUIREMENTS

The approximate chemical requirements for the municipal portion of Plans A, B and C are shown in Table E1 and E2 followed by a brief description of each chemical.

TABLE E1  
CHEMICAL REQUIREMENTS - MUNICIPAL FLOWS  
(TONS/DAY)

	<u>Chlorine</u> <u>Cl<sub>2</sub></u>	<u>Alum</u>	<u>Polymer</u>	<u>Methanol</u>	<u>Lime</u>
<u>Plan A</u>					
1980	35.7	23.1	1.0	-	133.0
1990	38.6	31.5	1.2	108.4	175.6
2000	43.1	35.2	1.4	121.0	196.0
2010	48.0	39.0	1.5	134.4	217.8
2020	52.6	42.5	1.7	146.4	238.0
<u>Plan B</u>					
1980	36.5	22.0	1.0	-	125.6
1990	40.2	28.5	1.2	101.0	163.5
2000	46.0	32.0	1.4	112.1	183.5
2010	51.6	35.8	1.5	123.0	203.0
2020	57.0	38.6	1.6	132.4	220.5
<u>Plan C</u>					
1980	31.5	25.2	1.0	-	81.0
1990	18.0	5.5	.5	-	40.0
2000	8.5	6.2	.5	-	38.1
2010	3.2	7.2	.2	-	27.1
2020	3.8	8.4	.2	-	31.5

TABLE E2  
CHEMICAL REQUIREMENTS - STORMWATER FLOWS  
(TONS/DAY)

	<u>Chlorine</u>	<u>Alum</u>	<u>Polymer</u>	<u>Methanol</u>	<u>Lime</u>	<u>Granular Activated Carbon</u>	<u>Powered Activated Carbon</u>
<u>Plan A</u>							
1980	2.6	2.7	.1	-	12.7	-	-
1990	8.9	5.2	.4	12.6	27.7	1.0	32.7
2000	9.6	5.9	.5	14.4	31.1	1.2	41.9
2010	10.1	6.5	.5	16.0	33.5	1.3	45.0
2020	10.2	6.7	.6	17.0	34.6	1.5	49.9
<u>Plan B</u>							
1980	2.5	2.8	.1	-	12.8	-	-
1990	9.0	5.1	.3	12.5	28.0	.8	27.4
2000	9.5	5.6	.4	13.8	30.3	.9	32.1
2010	9.6	5.8	.4	15.2	32.7	1.0	34.8
2020	10.3	6.3	.4	15.9	33.5	1.1	36.6
<u>Plan C</u>							
1980	5.6	3.5	.2	1.0	21.4	-	-
1990	6.6	1.2	.2	.8	12.0	.5	1.9
2000	7.4	1.4	.2	1.0	13.0	.7	22.8
2010	6.3	1.6	.2	1.3	12.3	.7	24.9
2020	6.6	1.6	.2	1.4	12.9	.8	26.4

### Chlorine

Chlorine gas is 5th in the list of the top 50 chemicals produced in the United States. National capacity at present is 28,960 tons per day. Annual increases in production have averaged 8% per year. The largest user of chlorine is the plastic industry in making vinyl chloride, with other large users being the pulp and paper industry and the dry cleaning and metal cleaning businesses. The Plan A 2020 demand for chlorine is 63 tons per day.

### Alum

Alum is produced from bauxite, clay and sulfuric acid and is 32nd on the list of the top 50 chemicals produced. Annual production has been increasing about 3% per year and now is about 1.2 million tons per year.

Under Plan A, 50 tons per day would be required or 18,250 tons per year in 2020.

### Methanol

Methanol is produced using natural gas (methane) and carbon dioxide. Its usage has increased 10% per year over the past several years making it 19th in the top 50 chemicals produced in 1971. Total capacity for production in the United States is 1.2 billion gallons per year. Currently, the largest use of methane is producing formaldehyde for the plastic industry.

Plan A has the highest requirement for methanol - 164 tons/day (2020) or about 20 million gallons annually which is 1.6% of current production. With the current problems with natural gas, and the possible nationwide demand for higher degree of wastewater treatment, methanol could be a potential limiting resource.

### Lime

Lime and limestone are among the most abundant materials on earth. According to the National Lime Association, only air, water, sand and gravel exceed it in volume. The lime commonly used in treatment processes is Quicklime (Ca O). Quicklime is formed by heating the limestone to the dissociation temperature for a sufficient duration to remove the carbon dioxide.

No attempt has been made to project industrial needs of these chemicals to the year 2020 and combine with the demands nationally by wastewater treatment. However, this should be done to compare to national and world resources as well as possible production. This type of impact should be addressed by the project evaluators.

## 2. POWER REQUIREMENTS

Power requirements for the portion of each plan have been computed and are shown in Table E3. For this report the requirements are based on general data developed for typical plants. A discussion for power requirements for the municipal wastewater treatment facilities can be found in the Technical Appendix, Phase II, Part D.

For the stormwater treatment facilities, the unit process power requirements were added on a per million gallon treated base with an allowance for pumping computed on fifty feet of total dynamic head

TABLE E3  
POWER REQUIREMENTS, MEGA WATT HOURS PER DAY

	1980	1990	2000	2010	2020
Plan A	1362	1788	2028	2229	2414
Plan B	1280	1684	1862	2019	2153
Plan C	1335	1321	1301	871	951

Comparing these requirements to existing need of 1000 megawatt hours per day, it can be seen that the additional environmental impact of generating this extra power must also be considered by the project evaluators.

Table E4 shows both the total power generating capacity of the station as well as that which is normally available within the area of Northeast Ohio. Table E4 shows the present generating capabilities.

TABLE E4  
POWER GENERATING STATION CAPACITIES IN 1972

CEI - Eastlake	1301 megawatts (447 mw available for CEI)
CEI - Avon Lake	1287 megawatts
CEI - Lakeshore	533 megawatts
Cleveland Municipal	110 megawatts
Ohio Edison - Gorge Plant	96 megawatts
Ashtabula	459 megawatts
Seneca Power Plant	381 megawatts (305 mw available for CEI)
Davis Beese (Scheduled for completion in 1975)	906 megawatts (431 mw available for CEI)
Perry (Planning Stage) (Scheduled for completion in early 1980's)	2410 megawatts (no percent of ownership established)
Ohio Edison Total Capacity	3844 megawatts

Ohio Edison serves 8973 square miles in 39 northern and central Ohio counties. Ohio Edison and CEI are part of a five company interconnected group - CAPCO (Central Area Power Coordination). Power can be brought into Northeast Ohio from plants located in several states under emergency conditions.

### 3. AIR POLLUTION

In the plans, several treatment facilities were equipped initially with incinerators for sludge volume reductions. The ash from these facilities is to be handled in a landfill.

The question arising from the use of incinerators is the potential for transfer of the pollution from the water or land to the air. In the preliminary design considerations and costing, allowances have been made for adequate air pollution control devices to meet existing standards.

A summary by decade of incinerator emissions is presented in Table E5 for each of the three plans. In addition to the stack flow rate and particulate emissions, the approximate concentrations of various constituents of the stack flow are given below:

SO <sub>2</sub>	6.2 ppm
NO <sub>x</sub>	74.7 ppm
HCl	4.5 ppm
CO <sub>2</sub>	5.8%

The figures presented above and in Table E5 are merely intended to be generalizations and should not be taken for specific data, since emissions depended largely on the emission control device, magnitude of excess air, ambient air quality, moisture content, auxiliary fuel used, type of sludge, degree of industrial contribution, and relative mixture of primary and secondary sludges. These data were averages from unpublished data of three multiple hearth incinerators equipped with scrubbers. The tests were run by the EPA using EPA Method 5. The pounds of emission decrease as more incinerators are phased out and sludge is applied to agricultural or strip-mined land.

**TABLE E5**  
**INCINERATOR EMISSIONS SUMMARY**

	1980	1990	2000	2010	2020
<u>Plan A</u>					
Daily Stack Flow Rate (DSCF)*	124,000,000	163,000,000	19,600,000	22,200,000	24,000,000
Daily Particulate Emissions (lbs)**	7,737	10,171	1,223	1,390	1,500
<u>Plan B</u>					
Daily Stack Flow Rate (DSCF)	124,000,000	161,000,000	19,600,000	22,200,000	24,000,000
Daily Particulate Emissions (lbs)	7,737	10,046	1,223	1,390	1,500
<u>Plan C</u>					
Daily Stack Flow Rate (DSCF)	115,000,000	87,000,000	93,500,000	-	-
Daily Particulate Emissions (lbs)	7,176	5,429	5,834	-	-

\*DSCP = dry standard cubic feet

\*\*Average particulate emission - 0.030 grains per standard cubic foot

#### 4. LAND

The land requirements in this section address only those required for the water-based portions of the three plans. Allowances have been made for a 500 foot buffer strip around each major municipal wastewater treatment plant. Buffer zones are not planned for stormwater treatment facilities as it is expected they will be placed in green areas within the PUD zoned areas. In areas that are currently developed, the land cost is so high that it would be too expensive to purchase more than absolutely necessary. The stormwater treatment facilities in general are used intermittently and would not have the odor or visual problems of a wastewater treatment plant.

Area for aerated lagoons is not included in this table; however, it will be included in the plan formulators report.

TABLE E6  
ACRES REQUIRED FOR WATER BASED TREATMENT PLANTS

<u>PLAN</u>	<u>WASTEWATER</u>	<u>STORMWATER</u>	<u>TOTAL</u>
A	729.5	1740.6	2470.1
B	728.0	2133.6	2899.9
C	517.0	2445.1	3000.4

## 5. MANPOWER

One of the major problems facing the wastewater treatment industry today is adequately trained manpower. The treatment processes required to meet the Level 2 effluent standards are complex in both the physical and theoretical sense. The level of training and education of the staff necessary to operate one of these plants must be increased which must be reflected in salary cost. As automation increases, the level of training for the maintenance staff will have to increase.

Manpower requirements shown in following table were projected assuming a high degree of automation. Manpower requirements are governed more by the type of unit process than by plant sizes. The numbers given reflect only plant operation, and do not include pumping station and sewer maintenance which usually is a function of local authority rather than the regional authority.

Manpower for the aerated lagoons is not included, but it will be included in the plan formulation report.

TABLE E7  
MANPOWER REQUIREMENTS FOR STORMWATER & WASTEWATER PLANTS IN 2020

MUNICIPAL PLANTS

	<u>Engineer</u>	<u>Chemists</u>	<u>Supervisors</u>	<u>Operators</u>	<u>Others</u>	<u>Total</u>
Plan A	40	20	70	210	670	1010
Plan B	34	17	60	180	575	870
Plan C	16	8	28	83	266	400

STORMWATER PLANTS

	<u>Engineer</u>	<u>Chemists</u>	<u>Supervisors</u>	<u>Operators</u>	<u>Others</u>	<u>Total</u>
Plan A	15	30	55	200	1200	1500
Plan B	8	16	28	101	606	758
Plan C	4	8	15	56	339	422

## APPENDIX A

This appendix includes all computer printout sheets for the municipal plants and stormwater districts of Plan A.

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - LIVERPOOL

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	20888	34335	47783	56963	66143	83212	100983	120508
FLOW (MGD)								
DOMESTIC	2.30	4.01	5.73	7.00	8.27	10.82	14.14	18.08
INDUSTRIAL	0.78	0.87	0.76	1.04	1.13	1.42	1.71	2.01
TOTAL	3.08	4.88	6.49	8.04	9.40	12.24	15.85	20.09
SLUDGE (TPD)								
GENERATED	3.26	5.18	7.09	8.53	10.72	13.95	18.07	22.90
DISCHARGED	2.09	3.31	4.54	5.46	6.86	8.93	11.56	14.66

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	6069		6800					6800		4855
EXPANSION	2824					9550				1336
EXPAND TO LEVEL 2	1768				3600			3600		2160
SLUDGE FACILITIES	1160		1300					1300		928
SLUDGE FACILITIES	754					2550				356
SEWERS	9794		12000							1200
SEWERS	1590				3834					1150
RESIDUAL	465									TOTAL 11987
NET CAPITAL	23497									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	269	427	586	763	960	1250	1619	2053
SLUDGE	(\$1000/YR)	28	45	62	68	78	101	131	167
SEWERS	(\$1000/YR)	0	59	59	79	79	79	79	79
TOTAL	(\$1000/YR)	298	533	708	911	1118	1431	1830	2299
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		1091	2545	3319	4159	8955	11458	14505	0
PRESENT WORTH (\$1000)		1091	2077	1932	1725	2648	1723	1108	0
NET O.+M. =		12307.							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	23497
O.+M. (\$1000)	12306
LAND (\$1000)	0
TOTAL (\$1000)	35804

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		524	524	524	524	524	524	524
EXPANSION					737	737	737	737
EXPAND TO LEVEL 2				308	308	308	308	308
SLUDGE FACILITIES		100	100	100	100	100	100	100
SLUDGE FACILITIES					196	196	196	196
SEWERS		868	868	868	868	868	868	868
SEWERS				277	277	277	277	277
TOTAL O.+M.	298	533	708	911	1118	1431	1830	2299
TOTAL ANNUAL	298	2025	2200	2988	4128	4443	4840	5309

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, SOUTHERLY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	552262	637743	723224	892422	1041620	1161810	1232326	1241914
FLOW (MGD)								
DOMESTIC	88.62	100.15	111.69	134.36	158.03	180.67	198.76	206.75
INDUSTRIAL	13.03	15.29	17.55	21.02	24.49	25.48	26.45	27.45
TOTAL	101.65	115.44	129.24	155.38	182.52	206.15	225.21	234.20
SLUDGE (TPD)								
GENERATED	107.75	122.37	136.99	165.23	203.07	235.01	256.74	266.99
DISCHARGED	68.36	78.32	87.68	105.75	133.17	150.41	164.31	170.87

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : STRIP MINE APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	16563						110130			47245
EXPAND TO LEVEL 1	49092		55000					55000		33269
EXPAND TO LEVEL 2	36511				88000					0
SLUDGE FACILITIES	14281		16000					16000		11423
SLUDGE FACILITIES	5620					19000				2650
SEWERS	16132		19765							1975
SEWERS	13953			23975						4794
SEWERS	5054					17086				6834
RESIDUAL	4431									
NET CAPITAL	152777									TOTAL 114205

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	6121	6952	7783	11521	15938	18058	19728	20515
SLUDGE	(\$1000/YR)	1179	1339	1500	1055	379	429	468	487
SEWERS	(\$1000/YR)	0	98	218	218	304	304	304	304
TOTAL	(\$1000/YR)	7301	8391	9502	12795	16672	18791	20501	21307
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		20591	36683	45711	60411	124541	137966	146820	0
PRESENT WORTH (\$1000)		20591	29940	26604	25064	36839	20753	11217	0
NET O.+M. =	171011								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	152777
O.+M. (\$1000)	171011
LAND (\$1000)	2780
TOTAL (\$1000)	326568

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						8502	8502	8502
EXPAND TO LEVEL 1		4245	4245	4245	4245	4245	4245	4245
EXPAND TO LEVEL 2				6793	6793	6793	6793	6793
SLUDGE FACILITIES		1235	1235	1235	1235	1235	1235	1235
SLUDGE FACILITIES				1466	1466	1466	1466	1466
SEWERS		1430	1430	1430	1430	1430	1430	1430
SEWERS			1735	1735	1735	1735	1735	1735
SEWERS				1237	1237	1237	1237	1237
TOTAL O.+M.	7301	8391	9502	12795	16672	18791	20501	21307
TOTAL ANNUAL	7301	15303	10150	20237	34817	45439	47148	47954

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## COMPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, ROCKY RIVER

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	61537	75438	89340	100620	111900	125805	137700	143930
FLOW (MGD)								
DOMESTIC	6.77	8.74	10.72	12.35	13.99	16.35	19.28	21.59
INDUSTRIAL	0.37	0.38	0.39	0.39	0.40	0.42	0.44	0.46
TOTAL	7.14	9.12	11.11	12.75	14.39	16.77	19.72	22.05
SLUDGE (TPD)								
GENERATED	5.00	6.39	7.78	8.92	10.07	11.74	13.80	15.43
DISCHARGED	3.20	4.09	4.98	5.71	6.45	7.51	8.83	9.88

TREATMENT PLANT TYPE : PHYSICAL CHEMICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	1263						8400			3603
EXPANSION	813					2750				384
EXPAND TO LEVEL 1	723			1050				1050		419
EXPAND TO LEVEL 2	275				560			560		336
SLUDGE FACILITIES	611			960					960	822
SLUDGE FACILITIES	428					1450				202
RESIDUAL	223									
NET CAPITAL	3891									5770

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	596	762	928	1102	1286	1499	1763	1971
SLUDGE	(\$1000/YR)	41	53	65	50	29	34	40	45
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	638	816	993	1153	1316	1533	1803	2016
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		1909	3711	4402	5062	10009	11721	13417	0
PRESENT WORTH (\$1000)		1909	3829	2562	2100	2960	1762	1025	0
NET O.+M. =		15349.6							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3891
O.+M. (\$1000)	15349
LAND (\$1000)	0
TOTAL (\$1000)	19241

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						648	648	648
EXPANSION					212	212	212	212
EXPAND TO LEVEL 1			90	90	90	90	90	90
EXPAND TO LEVEL 2				48	48	48	48	48
SLUDGE FACILITIES			74	74	74	74	74	74
SLUDGE FACILITIES					111	111	111	111
TOTAL O.+M.	638	816	993	1153	1316	1533	1803	2016
TOTAL ANNUAL	638	816	1157	1365	1851	2716	2986	3199

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, LAKEWOOD

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	80632	86244	91860	98662	105464	116240	123082	124784
FLOW (MGD)								
DOMESTIC	16.92	17.36	17.80	18.29	18.79	18.78	19.77	20.76
INDUSTRIAL	0.19	0.20	0.20	0.20	0.21	0.22	0.23	0.24
TOTAL	17.11	17.56	18.00	18.50	19.00	19.00	20.00	21.00
SLUDGE (TPD)								
GENERATED	18.14	18.61	19.08	19.61	21.66	21.66	22.80	23.94
DISCHARGED	11.61	11.91	12.21	12.55	13.86	13.86	14.59	15.32

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	1398						9300			3989
EXPANSION	3748		4200					4200		2998
EXPAND TO LEVEL 1	1933		2800				2000			399
EXPAND TO LEVEL 2	2702				5500			5500		3300
SLUDGE FACILITIES	2186		2450					2450		1749
SLUDGE FACILITIES	813					2750				384
RESIDUAL	497								TOTAL	12822
NET CAPITAL	12285									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	1249	1281	1314	1603	1907	1907	2007	2107
SLUDGE	(\$1000/YR)	139	142	146	100	55	55	58	61
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	1388	1424	1460	1703	1962	1962	2065	2169
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		3690	5913	6486	7515	13782	14145	14871	0
PRESENT WORTH (\$1000)		3690	4826	3775	3118	4076	2127	1136	0
NET O.+M. =		22750.7							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	12285
O.+M. (\$1000)	22750
LAND (\$1000)	0
TOTAL (\$1000)	35036

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						717	717	717
EXPANSION		324	324	324	324	324	324	324
EXPAND TO LEVEL 1		171	171	171	171	171	171	171
EXPAND TO LEVEL 2				471	471	471	471	471
SLUDGE FACILITIES		189	189	189	189	189	189	189
SLUDGE FACILITIES					212	212	212	212
TOTAL O.+M.	1388	1424	1460	1703	1962	1962	2065	2169
TOTAL ANNUAL	1388	2109	2144	2885	3329	4046	4149	4253

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - AURORA CENTRAL

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1990	2563	3136	4842	6549	11600	14020	16285
FLOW (MGD)								
DOMESTIC	0.22	0.30	0.38	0.60	0.62	1.51	1.96	2.44
INDUSTRIAL	0.00	0.11	0.22	0.36	0.50	0.22	0.35	0.54
TOTAL	0.22	0.41	0.60	0.96	1.32	1.73	2.31	2.98
SLUDGE (TPD)								
GENERATED	0.23	0.43	0.64	1.02	1.50	1.97	2.63	3.40
DISCHARGED	0.15	0.28	0.41	0.65	0.96	1.26	1.69	2.17

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	1383		1550					1550		1106
EXPANSION	724					2450				342
EXPAND TO LEVEL 2	442				900			900		540
SLUDGE FACILITIES	267		300					300		214
SLUDGE FACILITIES	162					550				76
SEWERS	558			960						191
SEWERS	319					1080				431
RESIDUAL	112								TOTAL	2909
NET CAPITAL	3746									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	30	56	82	140	204	268	358	462
SLUDGE	(\$1000/YR)	2	3	5	7	8	10	14	18
SEWERS	(\$1000/YR)	0	0	4	4	10	10	10	10
TOTAL	(\$1000/YR)	32	59	92	152	223	289	382	491
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		120	312	501	769	1800	2361	3069	0
PRESENT WORTH (\$1000)		120	255	291	319	532	355	234	0
NET O.+M. =	2109.17								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3746
O.+M. (\$1000)	2109
LAND (\$1000)	30
TOTAL (\$1000)	5885

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		119	119	119	119	119	119	119
EXPANSION					189	189	189	189
EXPAND TO LEVEL 2				77	77	77	77	77
SLUDGE FACILITIES		23	23	23	23	23	23	23
SLUDGE FACILITIES					42	42	42	42
SEWERS			69	69	69	69	69	69
SEWERS					78	78	78	78
TOTAL O.+M.	32	59	92	152	223	289	382	491
TOTAL ANNUAL	32	201	303	447	820	886	979	1088

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN A, MCFARLAND CREEK

CHMPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1635	3631	5227	10216	15206	20426	25120	28630
FLOW (MGD)								
DOMESTIC	0.18	0.40	0.63	1.26	1.90	2.66	3.52	4.29
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.18	0.40	0.63	1.26	1.90	2.66	3.52	4.29
SLUDGE (TPD)								
GENERATED	0.19	0.63	0.67	1.34	2.17	3.03	4.01	4.89
DISCHARGED	0.12	0.27	0.43	0.86	1.39	1.94	2.57	3.13

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	1785		2800					2000		1427
EXPANSION	958					3240				453
EXPAND TO LEVEL 2	589				1200			1200		720
SLUDGE FACILITIES	348		390					390		278
SLUDGE FACILITIES	189					640				89
SEWERS	3264		4800							400
RESIDUAL	130								TOTAL	3369
NET CAPITAL	7004									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	22	50	78	168	270	378	501	610
SLUDGE	(\$1000/YR)	1	3	4	8	10	14	19	23
SEWERS	(\$1000/YR)	0	19	19	19	19	19	19	19
TOTAL	(\$1000/YR)	23	73	103	196	300	413	540	653
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		127	361	614	1019	2506	3347	4193	0
PRESENT WORTH (\$1000)		127	295	357	423	741	503	320	0
NET O.+M.		2768.48							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	7004
O.+M. (\$1000)	2768
LAND (\$1000)	0
TOTAL (\$1000)	9773

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		154	154	154	154	154	154	154
EXPANSION					250	250	250	250
EXPAND TO LEVEL 2				102	102	102	102	102
SLUDGE FACILITIES		30	30	30	30	30	30	30
SLUDGE FACILITIES					49	49	49	49
SEWERS		289	289	289	289	289	289	289
TOTAL O.+M.	23	73	103	196	300	413	540	653
TOTAL ANNUAL	23	546	576	771	1174	1287	1414	1527

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN A - FOWLERS MILL

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	3820	4580	5340	6190	7040	8780	11000	13200
FLOW (MGD)								
DOMESTIC	0.42	0.53	0.64	0.76	0.88	1.14	1.54	1.98
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.42	0.53	0.64	0.76	0.88	1.14	1.54	1.98
SLUDGE (TPD)								
GENERATED	0.45	0.56	0.68	0.81	1.00	1.30	1.76	2.26
DISCHARGED	0.28	0.36	0.43	0.52	0.64	0.83	1.12	1.44

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	981		1100					1100		785
EXPANSION	535					1810				253
EXPAND TO LEVEL 2	324				660			660		396
SLUDGE FACILITIES	196		220					220		157
SLUDGE FACILITIES	118					400				55
SEWERS	799		979							97
RESIDUAL	67									
NET CAPITAL	2887									
									TOTAL	1745

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	61	77	93	121	152	197	266	343
SLUDGE	(\$1000/YR)	4	6	7	7	7	9	12	16
SEWERS	(\$1000/YR)	0	4	4	4	4	4	4	4
TOTAL	(\$1000/YR)	66	88	105	133	164	212	284	364
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		202	398	490	611	1323	1744	2280	0
PRESENT WORTH (\$1000)		202	324	285	253	391	262	174	0
NET O.+M. =									1895.23

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2887
O.+M. (\$1000)	1895
LAND (\$1000)	20
TOTAL (\$1000)	4802

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		84	84	84	84	84	84	84
EXPANSION					139	139	139	139
EXPAND TO LEVEL 2				56	56	56	56	56
SLUDGE FACILITIES		16	16	16	16	16	16	16
SLUDGE FACILITIES					30	30	30	30
SEWERS		70	70	70	70	70	70	70
TOTAL O.+M.	66	88	105	133	164	212	284	364
TOTAL ANNUAL	66	258	275	359	559	607	679	759

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, NEWBURY TWP.

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	3000	3585	4170	4845	5520	6910	8090	10300
FLOW (MGD)								
DOMESTIC	0.33	0.41	0.50	0.59	0.69	0.90	1.13	1.54
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.33	0.41	0.50	0.59	0.69	0.90	1.13	1.54
SLUDGE (TPD)								
GENERATED	0.35	0.44	0.53	0.63	0.79	1.03	1.29	1.76
DISCHARGED	0.22	0.28	0.34	0.40	0.50	0.66	0.82	1.12

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	770		863					863		616
EXPANSION	449					1520				212
EXPAND TO LEVEL 2	254				517			517		320
SLUDGE FACILITIES	174		195					195		139
SLUDGE FACILITIES	99					335				46
SEWERS	211					715				285
RESIDUAL	62									
NET CAPITAL	1896								TOTAL	1611

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	48	60	73	97	125	164	206	281
SLUDGE	(\$1000/YR)	3	4	5	5	6	8	10	14
SEWERS	(\$1000/YR)	0	0	0	0	3	3	3	3
TOTAL	(\$1000/YR)	52	65	78	103	135	176	220	298
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		154	295	374	491	1095	1391	1822	0
PRESENT WORTH (\$1000)									
		154	241	217	203	323	209	139	0
NET O.+M. =		1489.32							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1896
O.+M. (\$1000)	1489
LAND (\$1000)	15
TOTAL (\$1000)	3400

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		66	66	66	66	66	66	66
EXPANSION					117	117	117	117
EXPAND TO LEVEL 2				44	44	44	44	44
SLUDGE FACILITIES		15	15	15	15	15	15	15
SLUDGE FACILITIES					25	25	25	25
SEWERS					51	51	51	51
TOTAL O.+M.	52	65	78	103	135	176	220	298
TOTAL ANNUAL	52	146	159	228	453	494	538	616

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CHAGRIN FALLS

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	5956	7913	9870	12488	15107	18138	20804	22566
FLOW (MGD)								
DOMESTIC	0.46	0.92	1.19	1.54	1.89	2.36	2.91	3.40
INDUSTRIAL	0.15	0.16	0.16	0.16	0.16	0.17	0.17	0.18
TOTAL	0.81	1.08	1.35	1.70	2.05	2.53	3.08	3.58
SLUDGE (TPD)								
GENERATED	0.86	1.15	1.43	1.80	2.34	2.88	3.52	4.08
DISCHARGED	0.55	0.73	0.91	1.15	1.49	1.84	2.25	2.61

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	1919		2150					2150		1535
EXPANSION	633					2140				299
EXPAND TO LEVEL 2	589				1200			1200		720
SLUDGE FACILITIES	374		420					420		299
SLUDGE FACILITIES	189					640				89
SEWERS	195			336						67
SEWERS	108						720			432
RESIDUAL	133									
NET CAPITAL	3876									TOTAL 3443

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	101	134	167	232	306	378	461	535
SLUDGE	(\$1000/YR)	5	7	9	10	11	14	17	20
SEWERS	(\$1000/YR)	0	0	1	1	1	5	5	5
TOTAL	(\$1000/YR)	107	142	178	244	320	398	484	562
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		326	657	868	1158	2522	3100	3676	0
PRESENT WORTH (\$1000)		326	596	505	480	746	466	280	0
NET O.+M. =		3342.95							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3876
O.+M. (\$1000)	3342
LAND (\$1000)	179
TOTAL (\$1000)	7398

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		165	165	165	165	165	165	165
EXPANSION					165	165	165	165
EXPAND TO LEVEL 2				102	102	102	102	102
SLUDGE FACILITIES		32	32	32	32	32	32	32
SLUDGE FACILITIES					49	49	49	49
SEWERS			24	24	24	24	24	24
SEWERS						52	52	52
TOTAL O.+M.	107	142	178	244	320	398	484	562
TOTAL ANNUAL	107	339	399	567	857	985	1073	1151

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - FAIRMOUNT ROAD

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	628	2556	4485	8457	12430	16450	20030	22680
FLOW (MGD)								
DOMESTIC	0.07	0.31	0.54	1.05	1.55	2.14	2.80	3.40
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.07	0.31	0.54	1.05	1.55	2.14	2.80	3.40
SLUDGE (TPD)								
GENERATED	0.07	0.32	0.57	1.11	1.77	2.44	3.19	3.88
DISCHARGED	0.05	0.21	0.37	0.71	1.13	1.56	2.04	2.48

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	1562		1750					1750		1249
EXPANSION	789					2670				373
EXPAND TO LEVEL 2	491				1000			1000		600
SLUDGE FACILITIES	303		340					340		242
SLUDGE FACILITIES	183					620				86
SEWERS	567		720							72
SEWERS	147					498				199
RESIDUAL	109									
NET CAPITAL	3955									
									TOTAL	2824

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	9	40	70	146	231	320	419	508
SLUDGE	(\$1000/YR)	0	2	4	7	9	12	16	19
SEWERS	(\$1000/YR)	0	3	3	3	6	6	6	6
TOTAL	(\$1000/YR)	9	46	79	157	247	338	441	534
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		73	257	485	829	2057	2739	3427	0
PRESENT WORTH (\$1000)		73	209	282	344	608	412	261	0
NET O.+M. =									2192.96

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3955
O.+M. (\$1000)	2192
LAND (\$1000)	0
TOTAL (\$1000)	6148

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		135	135	135	135	135	135	135
EXPANSION					206	206	206	206
EXPAND TO LEVEL 2				85	85	85	85	85
SLUDGE FACILITIES		26	26	26	26	26	26	26
SLUDGE FACILITIES					47	47	47	47
SEWERS		52	52	52	52	52	52	52
SEWERS					36	36	36	36
TOTAL O.+M.	9	46	79	157	247	338	441	534
TOTAL ANNUAL	9	259	292	455	834	925	1028	1121

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN A - CHAGRIN E. BRANCH

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	4420	5205	5990	6985	7980	9600	11340	13020
FLOW (MGD)								
DOMESTIC	0.49	0.61	0.72	0.86	1.00	1.25	1.58	1.95
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.49	0.61	0.72	0.86	1.00	1.25	1.58	1.95
SLUDGE (TPD)								
GENERATED	0.52	0.64	0.76	0.91	1.14	1.43	1.80	2.22
DISCHARGED	0.33	0.41	0.49	0.58	0.73	0.91	1.15	1.42

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	1115		1250					1250		892
EXPANSION	461					1560				218
EXPAND TO LEVEL 2	368				750			750		450
SLUDGE FACILITIES	214		240					240		171
SLUDGE FACILITIES	156					530				74
SEWERS	668		819							81
SEWERS	315			542						108
RESIDUAL	77								TOTAL	1996
NET CAPITAL	3223									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	71	88	105	138	175	219	276	341
SLUDGE	(\$1000/YR)	5	6	7	7	7	9	11	14
SEWERS	(\$1000/YR)	0	4	6	6	6	6	6	6
TOTAL	(\$1000/YR)	76	98	119	152	189	235	295	363
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		230	448	558	701	1491	1863	2312	0
PRESENT WORTH (\$1000)		230	365	324	290	441	280	176	0
NET O.+M. =	2110.56								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3223
O.+M. (\$1000)	2110
LAND (\$1000)	20
TOTAL (\$1000)	5353

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		96	96	96	96	96	96	96
EXPANSION					120	120	120	120
EXPAND TO LEVEL 2				64	64	64	64	64
SLUDGE FACILITIES		18	18	18	18	18	18	18
SLUDGE FACILITIES					40	40	40	40
SEWERS		59	59	59	59	59	59	59
SEWERS			39	39	39	39	39	39
TOTAL O.+M.	76	98	119	152	189	235	295	363
TOTAL ANNUAL	76	271	331	428	625	671	731	799

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - WILLOUGHBY-EAST.

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	38324	45212	52100	64500	76900	97300	115200	124800
FLOW (MGD)								
DOMESTIC	4.22	5.23	6.25	7.93	9.61	12.65	16.13	19.02
INDUSTRIAL	1.33	1.50	1.67	1.84	2.00	2.42	2.83	3.25
TOTAL	5.55	6.73	7.92	9.76	11.61	15.07	18.96	22.27
SLUDGE (TPO)								
GENERATED	3.58	7.14	8.40	10.35	13.24	17.18	21.61	25.39
DISCHARGED	2.29	4.57	5.37	6.62	8.47	11.00	13.83	16.25

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : STRIP MINE APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	56						375			160
EXPANSION	2641			4150					4150	3556
EXPAND TO LEVEL 1	891			1400					1400	1199
EXPAND TO LEVEL 2	2210				4500			4500		2700
EXPANSION	947						6300			2702
SLUDGE FACILITIES	1115		1250					1250		892
SLUDGE FACILITIES	665					2250				314
SEWERS	489		600							60
SEWERS	1371			2356						471
SEWERS	646					2184				873
RESIDUAL	501									
NET CAPITAL	10533									
									TOTAL	12932

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	253	417	621	899	1228	1595	2006	2357
SLUDGE	(\$1000/YR)	11	20	21	26	33	43	55	64
SEWERS	(\$1000/YR)	0	2	14	14	25	25	25	25
TOTAL	(\$1000/YR)	264	441	657	941	1288	1664	2087	2447
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		927	2254	3277	4570	10370	13178	15928	0
PRESENT WORTH (\$1000)		927	1839	1907	1696	3067	1981	1216	0
NET O.+M. =		12837.9							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	10533
O.+M. (\$1000)	12537
LAND (\$1000)	0
TOTAL (\$1000)	23371

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						28	28	28
EXPANSION			320	320	320	320	320	320
EXPAND TO LEVEL 1			108	108	108	108	108	108
EXPAND TO LEVEL 2				386	386	386	386	386
EXPANSION						486	436	486
SLUDGE FACILITIES		96	96	96	96	96	96	96
SLUDGE FACILITIES					173	173	173	173
SEWERS		43	43	43	43	43	43	43
SEWERS			170	170	170	170	170	170
SEWERS					158	158	158	158
TOTAL O.+M.	264	441	657	941	1288	1664	2037	2447
TOTAL ANNUAL	264	580	1394	2064	2742	3632	4055	4415

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN A , BUTTERNUT CREEK

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	2180	2630	3080	3540	4000	5080	6360	7800
FLOW (MGD)								
DOMESTIC	0.24	0.31	0.37	0.44	0.50	0.66	0.89	1.17
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.24	0.31	0.37	0.44	0.50	0.66	0.89	1.17
SLUDGE (TPD)								
GENERATED	0.25	0.32	0.39	0.46	0.57	0.75	1.01	1.33
DISCHARGED	0.16	0.21	0.25	0.30	0.36	0.48	0.65	0.85

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	557		625					625		446
EXPAND TO LEVEL 2	184				375			375		225
EXPANSION	381					1290				180
SLUDGE FACILITIES	133		150					150		107
SLUDGE FACILITIES	82					280				39
SEWERS	391		480							48
SEWERS	272			468						93
RESIDUAL	44									
NET CAPITAL	1960									1139

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	35	44	54	74	98	130	175	230
SLUDGE	(\$1000/YR)	2	3	4	4	5	7	9	12
SEWERS	(\$1000/YR)	0	2	4	4	4	4	4	4
TOTAL	(\$1000/YR)	37	50	63	84	108	141	189	248
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		115	232	301	395	880	1165	1537	0
PRESENT WORTH (\$1000)		115	189	175	163	260	175	117	0
NET O.+M. =		1198.39							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1960
O.+M. (\$1000)	1198
LAND (\$1000)	12
TOTAL (\$1000)	3170

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		48	48	48	48	48	48	48
EXPAND TO LEVEL 2				32	32	32	32	32
EXPANSION					99	99	99	99
SLUDGE FACILITIES		11	11	11	11	11	11	11
SLUDGE FACILITIES					21	21	21	21
SEWERS		34	34	34	34	34	34	34
SEWERS			33	33	33	33	33	33
TOTAL O.+M.	37	50	63	84	108	141	189	248
TOTAL ANNUAL	37	145	191	244	390	423	471	529

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN A , EAST CLARIDON

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	730	950	1170	1425	1680	2380	2780	3200
FLOW (MGD)								
DOMESTIC	0.08	0.11	0.14	0.17	0.21	0.31	0.39	0.48
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.08	0.11	0.14	0.17	0.21	0.31	0.39	0.48
SLUDGE (TPD)								
GENERATED	0.08	0.12	0.15	0.19	0.24	0.35	0.44	0.55
DISCHARGED	0.05	0.07	0.09	0.12	0.15	0.23	0.28	0.35

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	234		263					263		187
EXPAND TO LEVEL 2	77				157			157		94
EXPANSION	159					540				75
SLUDGE FACILITIES	71		80					80		57
SLUDGE FACILITIES	44					150				20
SEWERS	97		120							12
RESIDUAL	17									
NET CAPITAL	667								TOTAL	447

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	11	16	20	30	43	64	81	99
SLUDGE	(\$1000/YR)	1	1	2	2	3	5	6	8
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	12	18	23	34	47	70	88	108
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		41	85	118	168	416	558	693	0
PRESENT WORTH (\$1000)		41	69	68	70	123	84	52	0
NET O.+M. =		510.124							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	667
O.+M. (\$1000)	510
LAND (\$1000)	5
TOTAL (\$1000)	1183

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		20	20	20	20	20	20	20
EXPAND TO LEVEL 2				13	13	13	13	13
EXPANSION					41	41	41	41
SLUDGE FACILITIES		6	6	6	6	6	6	6
SLUDGE FACILITIES					11	11	11	11
SEWERS		8	8	8	8	8	8	8
TOTAL O.+M.	12	18	23	34	47	70	88	108
TOTAL ANNUAL	12	148	186	243	431	454	472	492

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A . BURTON

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1100	1600	2100	2500	2900	3500	4200	5100
FLOW (MGD)								
DOMESTIC	0.12	0.19	0.25	0.31	0.36	0.45	0.59	0.76
INDUSTRIAL	0.06	0.06	0.07	0.08	0.09	0.11	0.13	0.15
TOTAL	0.18	0.25	0.32	0.38	0.45	0.56	0.72	0.91
SLUDGE (TPD)								
GENERATED	0.19	0.26	0.34	0.41	0.51	0.64	0.82	1.04
DISCHARGED	0.12	0.17	0.22	0.26	0.33	0.41	0.53	0.67

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	501		562					562		401
EXPANSION	272					920				128
EXPAND TO LEVEL 2	99					338				47
SLUDGE FACILITIES	124		140					140		99
SLUDGE FACILITIES	66					225				31
SEWERS	209			360						71
SEWERS	70					240				95
RESIDUAL	34									
NET CAPITAL	1311									876

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	25	36	47	68	92	116	150	190
SLUDGE	(\$1000/YR)	2	4	5	6	7	9	12	15
SEWERS	(\$1000/YR)	0	0	1	1	2	2	2	2
TOTAL	(\$1000/YR)	28	40	54	76	103	129	165	209
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		90	193	266	368	817	1034	1315	0
PRESENT WORTH (\$1000)		90	158	155	153	241	155	100	0
NET O.+M. =	1055.38								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1311
O.+M. (\$1000)	1055
LAND (\$1000)	9
TOTAL (\$1000)	2376

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		43	43	43	43	43	43	43
EXPANSION					71	71	71	71
EXPAND TO LEVEL 2					26	26	26	26
SLUDGE FACILITIES		10	10	10	10	10	10	10
SLUDGE FACILITIES					17	17	17	17
SEWERS			26	26	26	26	26	26
SEWERS					17	17	17	17
TOTAL O.+M.	28	40	54	76	103	129	165	209
TOTAL ANNUAL	28	93	133	155	313	339	375	421

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, MIDDLEFIELD

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1700	2350	3000	3850	4700	5200	7000	8200
FLOW (MGD)								
DOMESTIC	0.19	0.27	0.36	0.47	0.59	0.68	0.98	1.23
INDUSTRIAL	0.58	0.64	0.70	0.76	0.83	1.04	1.25	1.47
TOTAL	0.77	0.91	1.06	1.24	1.42	1.72	2.23	2.70
SLUDGE (TPD)								
GENERATED	0.82	0.97	1.12	1.31	1.62	1.96	2.54	3.08
DISCHARGED	0.52	0.62	0.72	0.84	1.04	1.25	1.63	1.97

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	1428		1600					1600		1142
EXPAND TO LEVEL 2	466				950			950		570
EXPANSION	573					1940				271
SLUDGE FACILITIES	276		310					310		221
SLUDGE FACILITIES	153					520				72
SEWERS	97		120							12
SEWERS	76			132						26
RESIDUAL	89									
NET CAPITAL	2984								TOTAL	2316

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	103	123	143	183	228	276	358	433
SLUDGE	(\$1000/YR)	6	8	9	9	9	11	14	17
SEWERS	(\$1000/YR)	0	0	1	1	1	1	1	1
TOTAL	(\$1000/YR)	110	132	153	193	238	288	374	452
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		319	586	712	887	1853	2328	2904	0
PRESENT WORTH (\$1000)									
		319	478	414	368	548	350	221	0
NET O.+M. = 2701.17									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2984
O.+M. (\$1000)	2701
LAND (\$1000)	27
TOTAL (\$1000)	5712

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		123	123	123	123	123	123	123
EXPAND TO LEVEL 2				81	81	81	81	81
EXPANSION					149	149	149	149
SLUDGE FACILITIES		23	23	23	23	23	23	23
SLUDGE FACILITIES					40	40	40	40
SEWERS		8	8	8	8	8	8	8
SEWERS			9	9	9	9	9	9
TOTAL O.+M.	110	132	153	193	238	288	374	452
TOTAL ANNUAL	110	268	319	441	675	726	811	889

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CURPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A , AUBURN TWP.

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1550	1940	2330	2725	3120	4080	4930	5600
FLOW (MGD)								
DOMESTIC	0.17	0.22	0.28	0.33	0.39	0.53	0.69	0.84
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.17	0.22	0.28	0.33	0.39	0.53	0.69	0.84
SLUDGE (TPD)								
GENERATED	0.18	0.24	0.30	0.36	0.44	0.60	0.79	0.96
DISCHARGED	0.12	0.15	0.19	0.23	0.28	0.39	0.50	0.61

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	434		487					487		347
EXPAND TO LEVEL 2	143				292			292		175
EXPANSION	266					900				125
SLUDGE FACILITIES	111		125					125		89
SLUDGE FACILITIES	66					225				31
SEWERS	195			336						67
RESIDUAL	32								TOTAL	836
NET CAPITAL	1185									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>
PLANT	(\$1000/YR)	24	32	40	59	81	110	143	174
SLUDGE	(\$1000/YR)	1	2	3	3	4	6	8	10
SEWERS	(\$1000/YR)	0	0	1	1	1	1	1	1
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>26</u>	<u>35</u>	<u>45</u>	<u>64</u>	<u>87</u>	<u>118</u>	<u>153</u>	<u>186</u>
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		81	166	226	312	724	956	1196	0
PRESENT WORTH (\$1000)		81	135	132	129	214	143	91	0
NET O.+M. =		929.049							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1185
O.+M. (\$1000)	929
LAND (\$1000)	8
TOTAL (\$1000)	2122

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		37	37	37	37	37	37	37
EXPAND TO LEVEL 2				25	25	25	25	25
EXPANSION					69	69	69	69
SLUDGE FACILITIES		9	9	9	9	9	9	9
SLUDGE FACILITIES					17	17	17	17
SEWERS			24	24	24	24	24	24
TOTAL O.+M.	26	35	45	64	87	118	153	186
TOTAL ANNUAL	26	81	115	159	268	299	334	367

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN A, TROY TWP.

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	820	1035	1250	1465	1680	2230	2720	3140
FLOW (MGD)								
DOMESTIC	0.09	0.12	0.15	0.18	0.21	0.29	0.38	0.47
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.09	0.12	0.15	0.18	0.21	0.29	0.38	0.47
SLUDGE (TPD)								
GENERATED	0.10	0.13	0.16	0.19	0.24	0.33	0.43	0.54
DISCHARGED	0.06	0.08	0.10	0.12	0.15	0.21	0.28	0.34

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	234		263					263		167
EXPAND TO LEVEL 2	77				158			158		94
EXPANSION	153					520				72
SLUDGE FACILITIES	71		80					80		57
SLUDGE FACILITIES	44					150				20
SEWERS	28					96				38
RESIDUAL	18									
NET CAPITAL	592									471

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	13	17	21	31	43	60	79	97
SLUDGE	(\$1000/YR)	1	1	1	2	2	3	4	5
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	14	18	23	33	46	64	84	104
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		43	87	118	165	390	522	661	0
PRESENT WORTH (\$1000)		43	71	68	68	115	78	50	0
NET O.+M. =									496.667

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	592
O.+M. (\$1000)	496
LAND (\$1000)	5

TOTAL (\$1000) 1093

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		20	20	20	20	20	20	20
EXPAND TO LEVEL 2				13	13	13	13	13
EXPANSION					40	40	40	40
SLUDGE FACILITIES		6	6	6	6	6	6	6
SLUDGE FACILITIES					11	11	11	11
SEWERS					6	6	6	6
TOTAL O.+M.	14	18	23	33	46	64	84	104
TOTAL ANNUAL	14	43	49	72	142	160	180	200

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A , MANTUA

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1440	1645	1850	2115	2380	2940	3620	3975
FLOW (MGD)								
DOMESTIC	0.16	0.19	0.22	0.26	0.30	0.38	0.51	0.60
INDUSTRIAL	0.13	0.14	0.15	0.16	0.17	0.20	0.23	0.26
TOTAL	0.29	0.33	0.37	0.42	0.47	0.58	0.74	0.86
SLUDGE (TPD)								
GENERATED	0.31	0.35	0.39	0.45	0.54	0.66	0.84	0.98
DISCHARGED	0.20	0.22	0.25	0.28	0.34	0.42	0.54	0.63

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	526		590					590		421
EXPAND TO LEVEL 2	172				352			352		211
EXPANSION	230					780				109
SLUDGE FACILITIES	124		140					140		99
SLUDGE FACILITIES	66					225				31
RESIDUAL	33									
NET CAPITAL	1087									873

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<hr/>		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
PLANT	(\$1000/YR)	42	48	54	74	97	120	153	178
SLUDGE	(\$1000/YR)	3	3	4	4	5	7	9	10
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
<hr/>		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
TOTAL	(\$1000/YR)	45	52	58	79	103	127	163	189
<hr/>									
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		128	226	281	374	813	1022	1239	0
<hr/>		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
PRESENT WORTH (\$1000)		128	184	164	155	240	153	94	0
<hr/>		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
NET O.+M. =		1121.43							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1087
O.+M. (\$1000)	1121
LAND (\$1000)	0
TOTAL (\$1000)	2209

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		45	45	45	45	45	45	45
EXPAND TO LEVEL 2				30	30	30	30	30
EXPANSION					60	60	60	60
SLUDGE FACILITIES		10	10	10	10	10	10	10
SLUDGE FACILITIES					17	17	17	17
TOTAL O.+M.	45	52	58	79	103	127	163	189
TOTAL ANNUAL	45	107	113	164	265	289	325	351

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - AKRON

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	344877	364584	384292	398001	411711	481404	503361	509668
FLOW (MGD)								
DOMESTIC	55.81	62.46	69.10	75.90	82.71	95.53	112.55	132.51
INDUSTRIAL	15.19	15.09	14.99	15.05	15.12	15.80	16.48	17.16
TOTAL	71.00	77.54	84.09	90.96	97.83	111.33	129.03	149.67
SLUDGE (TPD)								
GENERATED	75.26	82.20	89.14	96.42	111.53	126.92	147.09	170.62
DISCHARGED	48.17	52.61	57.05	61.71	71.38	81.23	94.14	109.20

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : STRIP MINE APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	586						3900			1673
EXPAND TO LEVEL 1	7140		8000					8000		5711
EXPAND TO LEVEL 2	10808				22000			22000		13200
EXPANSION	20122				48500					0
SLUDGE FACILITIES	7854		8800					8800		6283
SLUDGE FACILITIES	4771				11500					0
SEWERS	88		108							10
SEWERS	698			1200						239
SEWERS	1064					3600				1439
RESIDUAL	1108									TOTAL 28559
NET CAPITAL	52028									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	4275	4670	5364	6723	8569	9752	11303	13111	
SLUDGE (\$1000/YR)	412	450	488	351	203	231	268	311	
SEWERS (\$1000/YR)	0	0	6	6	24	24	24	24	
TOTAL (\$1000/YR)	4688	5120	5558	7081	8797	10008	11596	13447	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		12870	21893	25913	32553	66044	75870	87944	0
PRESENT WORTH (\$1000)		12870	17869	15081	13506	19535	11410	6718	0
NET O.+M. =	96993.9								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	52028
O.+M. (\$1000)	96993
LAND (\$1000)	118
TOTAL (\$1000)	149140

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						301	301	301
EXPAND TO LEVEL 1		617	617	617	617	617	617	617
EXPAND TO LEVEL 2				1887	1887	1887	1887	1887
EXPANSION				3744	3744	3744	3744	3744
SLUDGE FACILITIES		679	679	679	679	679	679	679
SLUDGE FACILITIES				887	887	887	887	887
SEWERS		7	7	7	7	7	7	7
SEWERS			86	86	86	86	86	86
SEWERS					260	260	260	260
TOTAL O.+M.	4688	5120	5558	7081	8797	10008	11596	13447
TOTAL ANNUAL	4688	6423	6947	14988	16964	18476	20094	21915

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN A, KENT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	33024	48932	64841	81701	98562	121504	139790	150600
FLOW (MGD)								
DOMESTIC	3.63	5.70	7.78	10.05	12.32	15.80	19.57	22.59
INDUSTRIAL	2.20	2.55	2.90	3.25	3.61	4.35	5.08	5.82
TOTAL	5.83	8.25	10.68	13.30	15.93	20.15	24.65	28.41
SLUDGE (TPD)								
GENERATED	5.01	7.10	9.18	11.44	13.70	17.33	21.20	24.43
DISCHARGED	5.01	7.10	9.18	11.44	13.70	17.33	21.20	24.43

TREATMENT PLANT TYPE : PHYSICAL CHEMICAL PLANT

SLUDGE HANDLING TYPE : INCINERATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	6998		7240				7240			1447
EXPAND TO LEVEL 2	275				560			560		336
EXPANSION	1989					5680			5680	4544
SEWERS	3917		4800							480
RESIDUAL	264								TOTAL	6807
NET CAPITAL	12916									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	487	487	689	892	1114	1337	1691	2069	2385
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	23	23	23	23	23	23	23
TOTAL (\$1000/YR)	487	487	713	916	1138	1361	1715	2093	2409
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		1576	3342	4213	5124	10805	13376	15811	0
PRESENT WORTH (\$1000)		1576	2728	2452	2126	3196	2011	1207	0
NET O.+M. =	15299.2								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	12916
O.+M. (\$1000)	15299
LAND (\$1000)	520
TOTAL (\$1000)	28735

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		621	621	621	621	621	621	621
EXPAND TO LEVEL 2				48	48	48	48	48
EXPANSION					487	487	487	487
SEWERS		347	347	347	347	347	347	347
TOTAL O.+M.	487	713	916	1138	1361	1715	2093	2409
TOTAL ANNUAL	487	1681	1884	2154	2864	3218	3596	4212

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CURPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - RAVENNA

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	13445	17884	22324	29742	37160	58650	68220	74315
FLOW (MGD)								
DOMESTIC	1.48	2.08	2.68	3.66	4.64	7.62	9.55	11.15
INDUSTRIAL	0.57	0.62	0.67	0.72	0.77	0.91	1.05	1.19
TOTAL	2.05	2.70	3.35	4.38	5.41	8.53	10.60	12.34
SLUDGE (TPD)								
GENERATED	2.17	2.86	3.55	4.66	6.17	9.72	12.08	14.07
DISCHARGED	1.39	1.83	2.27	2.97	3.95	6.22	7.73	9.00

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : STRIP MINE APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	195						1300			557
EXPAND TO LEVEL 1	289		300				300			59
EXPANSION	3088		3460					3460		2470
EXPAND TO LEVEL 2	1129				2300			2300		1380
EXPANSION	2070					7000				979
SLUDGE FACILITIES	776		870					870		621
SLUDGE FACILITIES	443					1500				209
SEWERS	1204		1476							147
RESIDUAL	249									
NET CAPITAL	8950									TOTAL 6426

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	202	266	330	455	592	934	1160	1351
SLUDGE	(\$1000/YR)	8	11	14	15	16	26	33	38
SEWERS	(\$1000/YR)	0	7	7	7	7	7	7	7
TOTAL	(\$1000/YR)	210	284	351	478	616	968	1201	1397
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		650	1305	1702	2245	5565	7617	9124	0
PRESENT WORTH (\$1000)		650	1065	990	931	1646	1145	697	0
NET O.+M. =		7127.31							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	8950
O.+M. (\$1000)	7127
LAND (\$1000)	0
TOTAL (\$1000)	16077

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						100	100	100
EXPAND TO LEVEL 1		25	25	25	25	25	25	25
EXPANSION		267	267	267	267	267	267	267
EXPAND TO LEVEL 2				197	197	197	197	197
EXPANSION					540	540	540	540
SLUDGE FACILITIES		67	67	67	67	67	67	67
SLUDGE FACILITIES					115	115	115	115
SEWERS		106	106	106	106	106	106	106
TOTAL O.+M.	210	284	351	478	616	968	1201	1397
TOTAL ANNUAL	210	749	816	1140	1933	2385	2618	2814

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

ASTEWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A . RANDOLPH

	1972	1975	1980	1985	1990	2000	2010	2020
PUPULATION	1820	2160	2500	2850	3200	3840	4650	5000
FLOW (MGD)								
DOMESTIC	0.20	0.25	0.30	0.35	0.40	0.50	0.65	0.75
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.20	0.25	0.30	0.35	0.40	0.50	0.65	0.75
SLUDGE (TPD)								
GENERATED	0.21	0.27	0.32	0.37	0.46	0.57	0.74	0.86
DISCHARGED	0.14	0.17	0.20	0.24	0.29	0.36	0.47	0.55

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : AGRICULTURAL APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	446		500					500		356
EXPAND TO LEVEL 2	105					300			300	240
EXPANSION	207					700				97
SLUDGE FACILITIES	111		125					125		89
SLUDGE FACILITIES	60					205				28
SEWERS	172		211							21
RESIDUAL	32									
NET CAPITAL	1070									834

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	29	36	43	61	83	104	135	156	
SLUDGE (\$1000/YR)	3	4	4	5	6	8	11	13	
SEWERS (\$1000/YR)	0	1	1	1	1	1	1	1	
TOTAL (\$1000/YR)	32	41	49	68	91	113	147	170	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	97	187	242	327	720	918	1116	0	
PRESENT WORTH (\$1000)	97	152	141	136	213	138	85	0	

NET O.+M. = 963.809

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1070
O.+M. (\$1000)	963
LAND (\$1000)	8
TOTAL (\$1000)	2042

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		38	38	38	38	38	38	38
EXPAND TO LEVEL 2					25	25	25	25
EXPANSION					54	54	54	54
SLUDGE FACILITIES		9	9	9	9	9	9	9
SLUDGE FACILITIES					15	15	15	15
SEWERS		15	15	15	15	15	15	15
TOTAL O.+M.	32	41	49	68	91	113	147	170
TOTAL ANNUAL	32	105	113	132	250	272	306	329

ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A , EASTERLY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	454765	478288	501812	539314	576316	630533	659688	657573
FLOW (MGD)								
DOMESTIC	113.00	120.15	127.30	130.95	134.60	143.60	148.80	156.10
INDUSTRIAL	12.00	12.35	12.70	13.05	13.40	14.40	15.20	15.90
TOTAL	125.00	132.50	140.00	144.00	148.00	158.00	164.00	172.00
SLUDGE (TPD)								
GENERATED	132.50	140.45	148.40	152.64	168.72	180.12	186.96	196.08
DISCHARGED	84.80	89.89	94.98	97.69	107.93	115.28	119.65	125.49

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : STRIP MINE APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	15017						99853			42836
EXPAND TO LEVEL 1	13835		15500					15500		11066
EXPAND TO LEVEL 2	21125				43000			43000		25800
SLUDGE FACILITIES	13388		15000					15000		10709
SLUDGE FACILITIES	5028					17000				2379
SEWERS	840			1458						291
RESIDUAL	3611								TOTAL	93085
NET CAPITAL	65633									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	7528	7979	8431	10643	12964	13840	14366	15067
SLUDGE	(\$1000/YR)	1450	1537	1624	974	307	328	341	357
SEWERS	(\$1000/YR)	0	0	7	7	7	7	7	7
TOTAL	(\$1000/YR)	8979	9517	10063	11625	13279	14176	14714	15432
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		24270	40143	44464	51057	96421	101460	105869	0
PRESENT WORTH (\$1000)		24270	32764	25878	21183	28521	15259	8088	0
NET O.+M. =		155967.							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	65633
O.+M. (\$1000)	155966
LAND (\$1000)	0
TOTAL (\$1000)	221600

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						7703	7703	7703
EXPAND TO LEVEL 1		1196	1196	1196	1196	1196	1196	1196
EXPAND TO LEVEL 2				3649	3630	3689	3689	3630
SLUDGE FACILITIES		1157	1157	1157	1157	1157	1157	1157
SLUDGE FACILITIES					1312	1312	1312	1312
SEWERS			105	105	105	105	105	105
TOTAL O.+M.	8979	9517	10063	11625	13279	14176	14714	15432
TOTAL ANNUAL	8979	11672	12523	17775	20741	29347	29085	30602

# WASTEWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, EUCLID

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	115110	128864	142618	159028	175439	204530	226617	237030
FLOW (MGD)								
DOMESTIC	12.66	14.88	17.11	19.52	21.93	26.59	31.73	35.55
INDUSTRIAL	1.87	1.93	2.00	2.06	2.12	2.01	1.90	1.79
TOTAL	14.53	16.82	19.11	21.58	24.05	28.60	33.63	37.34
SLUDGE (TPD)								
GENERATED	15.40	17.83	20.26	22.87	27.42	32.60	38.34	42.57
DISCHARGED	9.86	11.41	12.96	14.64	17.55	20.87	24.54	27.24

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : STRIP MINE APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	1804						12000			5148
EXPAND TO LEVEL 1	1695		1900					1900		1356
EXPANSION	3124		3500					3500		2498
EXPAND TO LEVEL 2	3193				6500			6500		3900
EXPANSION	2957					10000				1399
SLUDGE FACILITIES	2142		2400					2400		1713
SLUDGE FACILITIES	1064					3600				503
RESIDUAL	641									
NET CAPITAL	15342									
									TOTAL	16521

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	1034	1197	1360	1732	2150	2557	3007	3339
SLUDGE	(\$1000/YR)	112	130	147	108	60	71	83	93
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	1146	1327	1508	1841	2210	2628	3091	3432
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		3246	5812	6866	8307	16995	20088	22909	0
PRESENT WORTH (\$1000)		3246	4744	3996	3446	5027	3021	1750	0
NET O.+M. =		25232.1							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	15342
O.+M. (\$1000)	25232
LAND (\$1000)	360
TOTAL (\$1000)	40934

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						926	926	926
EXPAND TO LEVEL 1		146	146	146	146	146	146	146
EXPANSION		270	270	270	270	270	270	270
EXPAND TO LEVEL 2				557	557	557	557	557
EXPANSION					771	771	771	771
SLUDGE FACILITIES		185	185	185	185	185	185	185
SLUDGE FACILITIES					277	277	277	277
TOTAL O.+M.	1146	1327	1508	1841	2210	2628	3091	3432
TOTAL ANNUAL	1146	1928	2109	2999	4416	5760	6223	6564

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, WESTERLY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	160000	155500	151000	151000	151000	152000	153000	160000
FLOW (MGD)								
DOMESTIC	29.01	28.70	28.40	28.75	29.10	30.09	31.08	32.97
INDUSTRIAL	6.90	7.82	8.74	9.66	10.59	11.13	11.67	12.21
TOTAL	35.91	36.52	37.14	38.41	39.69	41.22	42.75	45.18
SLUDGE (TPD)								
GENERATED	30.88	31.41	31.94	33.04	34.13	35.45	36.76	38.85
DISCHARGED	30.88	31.41	31.94	33.04	34.13	35.45	36.76	38.85

TREATMENT PLANT TYPE : PHYSICAL CHEMICAL PLANT

SLUDGE HANDLING TYPE : INCINERATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXPANSION	38664		48000				40000			7999
EXISTING PLANT	5693					19247				2694
RESIDUAL	414									
NET CAPITAL	43942									
									TOTAL	10694

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	3014	3066	3117	3224	3331	3460	3588	3792
SLUDGE	(\$1000/YR)	0	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	3014	3066	3117	3224	3331	3460	3588	3792
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		7979	12677	13003	13441	23853	24755	25922	0
PRESENT WORTH (\$1000)		7979	10347	7567	5577	7055	3723	1980	0
NET O.+M. =		44231.1							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	43942
O.+M. (\$1000)	44231
LAND (\$1000)	0
TOTAL (\$1000)	88173

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXPANSION		3431	3431	3431	3431	3431	3431	3431
EXISTING PLANT					1485	1485	1485	1485
TOTAL O.+M.	3014	3066	3117	3224	3331	3460	3588	3792
TOTAL ANNUAL	3014	6497	6548	6655	8247	8376	8504	8708

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CHARDON

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1800	2980	4160	6080	8000	10000	12100	13300
FLOW (MGD)								
DOMESTIC	0.02	0.03	0.05	0.07	0.10	0.13	0.17	0.20
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.02	0.03	0.05	0.07	0.10	0.13	0.17	0.20
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	34			50				50		19
SEWERS	203			350						69
RESIDUAL	3									
NET CAPITAL	234								TOTAL	89

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	0	0	1
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	1	1	1	1	1	1	1
TOTAL (\$1000/YR)	0	0	0	2	2	2	2	2	2
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	4	8	9	16	18	19	0	0
PRESENT WORTH (\$1000)	0	3	4	3	4	2	1	0	0
NET O.+M. =	21.5991								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	234
O.+M. (\$1000)	21
LAND (\$1000)	0
TOTAL (\$1000)	256

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT			4	4	4	4	4	4
SEWERS			25	25	25	25	25	25
TOTAL O.+M.	0	0	2	2	2	2	2	2
TOTAL ANNUAL	0	0	31	31	31	32	32	32

ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
 A DISCOUNT RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A . CH-162

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	43	67	89	92	96	103	107
ANNUAL RUNOFF	0	597	1195	1238	1282	1366	1493	1679
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	872	1744	1808	1871	1994	2179	2451
TREATMENT PLANT	0	0	728	755	782	833	910	1024

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	330			520					520	445
BASIN	523			900						179
PIPES	291			500						99
RESIDUAL	28								TOTAL	725
NET CAPITAL	1117									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	296	347	401	427	467	525
SLUDGE	(\$1000/YR)	0	0	48	50	52	55	60	68
SEWERS	(\$1000/YR)	0	0	2	2	2	2	2	2
TOTAL	(\$1000/YR)	0	0	347	400	456	485	530	596
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	1533	1755	3307	3569	3958	0
PRESENT WORTH (\$1000)		0	0	892	728	978	536	302	0
NET O.+M. =	3438.43								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1117
O.+M. (\$1000)	3438
LAND (\$1000)	700
TOTAL (\$1000)	5256

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			40	40	40	40	40	40
BASIN			65	65	65	65	65	65
PIPES			36	36	36	36	36	36
TOTAL O.+M.	0	0	347	400	456	485	530	596
TOTAL ANNUAL	0	0	489	541	597	627	672	737

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CH-3

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	4	9	11	14	19	24	24
ANNUAL RUNOFF	0	72	145	181	218	291	363	363
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	105	211	264	318	424	529	529
TREATMENT PLANT	0	0	88	110	132	177	221	221

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	145				350					105
BASIN	46				112					0
PIPES	124				300					90
RESIDUAL	7									
NET CAPITAL	308									TOTAL 195

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	63	63	78	98	98	
SLUDGE (\$1000/YR)	0	0	0	8	8	11	14	14	
SEWERS (\$1000/YR)	0	0	0	1	1	1	1	1	
TOTAL (\$1000/YR)	0	0	0	73	73	91	114	114	
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	301	581	724	802	0	
PRESENT WORTH (\$1000)	0	0	0	125	171	108	61	0	
NET O.+M. =	467.446								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	308
O.+M. (\$1000)	467
LAND (\$1000)	73
TOTAL (\$1000)	849

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				25	25	25	25	25
BASIN				8	8	8	8	8
PIPES				21	21	21	21	21
TOTAL O.+M.	0	0	0	73	73	91	114	114
TOTAL ANNUAL	0	0	0	129	129	167	170	170

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A . CH-4

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	1	3	5	7	10
ANNUAL RUNOFF	0	0	0	30	60	89	119	149
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	87	129	173	217
TREATMENT PLANT	0	0	0	0	36	54	72	90

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	13					46				6
BASIN	62					210				83
PIPES	88					300				119
RESIDUAL	8									
NET CAPITAL	156									
									TOTAL	210

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	17	24	32	40
SLUDGE	(\$1000/YR)	0	0	0	0	2	3	4	6
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	21	29	38	47
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	177	237	303	0
PRESENT WORTH (\$1000)									
		0	0	0	0	52	35	23	0
NET O.+M. = 111.339									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	156
O.+M. (\$1000)	111
LAND (\$1000)	11
TOTAL (\$1000)	278

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					3	3	3	3
BASIN					15	15	15	15
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	21	29	38	47
TOTAL ANNUAL	0	0	0	0	41	69	78	88

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CH-5

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	6	10	12
ANNUAL RUNOFF	0	0	0	0	0	108	162	194
SLUDGE QUANTITIES (DY/YR)								
SEDIMENT BASIN	0	0	0	0	0	157	234	283
TREATMENT PLANT	0	0	0	0	0	65	98	118

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	8						59			25
BASIN	37						250			150
PIPES	45						300			180
RESIDUAL	13									
NET CAPITAL	77									355

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	29	43	52
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	6	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	1	1	1
TOTAL (\$1000/YR)	0	0	0	0	0	0	35	51	61
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	305	399	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	45	30	0
NET O.+M. =	76.38%								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	77
O.+M. (\$1000)	76
LAND (\$1000)	15
TOTAL (\$1000)	169

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING						4	4	4
BASIN						18	18	18
PIPES						21	21	21
TOTAL O.+M.	0	0	0	0	0	35	31	41
TOTAL ANNUAL	0	0	0	0	0	79	96	106

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CH-6

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	3	6	11	15	18
ANNUAL RUNOFF	0	0	0	53	106	161	214	267
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	154	235	312	389
TREATMENT PLANT	0	0	0	0	64	98	130	162

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	24					83				11
BASIN	88					300				119
PIPES	88					300				119
RESIDUAL	9									
NET CAPITAL	192									TOTAL 251

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	30	43	57	72
SLUDGE	(\$1000/YR)	0	0	0	0	4	6	8	10
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>36</u>	<u>51</u>	<u>68</u>	<u>84</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	309	419	535	0
PRESENT WORTH (\$1000)									
		0	0	0	0	91	63	40	0
NET O.+M. = 195.554									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	192
O.+M. (\$1000)	195
LAND (\$1000)	20
TOTAL (\$1000)	407

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					6	6	6	6
BASIN					21	21	21	21
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	36	51	68	84
TOTAL ANNUAL	0	0	0	0	86	101	117	134

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A, CH-7

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	1	2	3	3	3
ANNUAL RUNOFF	0	0	0	15	30	45	61	61
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	75	112	152	152
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	502					1700				237
BASIN	29					100				39
PIPES	59					200				79
RESIDUAL	13									
NET CAPITAL	577									357

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	7	11	15	15	
SLUDGE (\$1000/YR)	0	0	0	0	1	2	3	3	
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	
TOTAL (\$1000/YR)	0	0	0	0	10	15	20	20	
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	89	123	140	0	
PRESENT WORTH (\$1000)	0	0	0	0	26	18	10	0	
NET O.+M. =	55.7411								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	577
O.+M. (\$1000)	55
LAND (\$1000)	4
TOTAL (\$1000)	637

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					131	131	131	131
BASIN					7	7	7	7
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	10	15	20	20
TOTAL ANNUAL	0	0	0	0	163	166	173	173

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A, CH-8

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	1	2	2	4	4
ANNUAL RUNOFF	0	0	0	24	48	48	73	73
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	120	120	182	182
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	591					2000				279
BASIN	32					110				43
PIPES	782					2647				1058
RESIDUAL	53									
NET CAPITAL	1353									TOTAL 1362

TABLE II : PRESENT WORTH - O.+M. COSTS

		<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
PLANT	(\$1000/YR)	0	0	0	0	12	12	18	18
SLUDGE	(\$1000/YR)	0	0	0	0	3	3	4	4
SEWERS	(\$1000/YR)	0	0	0	0	13	13	13	13
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>28</u>	<u>28</u>	<u>36</u>	<u>36</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	198	225	253	0
PRESENT WORTH (\$1000)									
		0	0	0	0	58	33	19	0
NET O.+M. = 111.954									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1353
O.+M. (\$1000)	111
LAND (\$1000)	1
TOTAL (\$1000)	1466

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					154	154	154	154
BASIN					7	7	7	7
PIPES					191	191	191	191
TOTAL O.+M.	0	0	0	0	28	28	36	36
TOTAL ANNUAL	0	0	0	0	382	382	390	390

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CH-9

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	4	6	9	11
ANNUAL RUNOFF	0	0	0	31	62	94	126	157
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	155	235	315	392
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	798					2700				377
BASIN	47					160				63
PIPES	59					200				79
RESIDUAL	20									
NET CAPITAL	884									521

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	15	23	31	39
SLUDGE	(\$1000/YR)	0	0	0	0	3	5	7	9
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	20	30	40	50
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	178	248	317	0
PRESENT WORTH (\$1000)									
		0	0	0	0	52	37	24	0
NET O.+M. =		114.35							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	884
O.+M. (\$1000)	114
LAND (\$1000)	12

TOTAL (\$1000) 1011

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					208	208	208	208
BASIN					11	11	11	11
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	20	30	40	50
TOTAL ANNUAL	0	0	0	0	254	264	274	284

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CH-10

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	14	29	30	31	32	32	32
ANNUAL RUNOFF	0	197	395	410	426	457	457	457
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	493	987	1026	1065	1142	1142	1142
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	580				1400					0
PLANT EXPANSION	916					3100				433
BASIN	114				275					82
PIPES	1155				2784					835
RESIDUAL	52									
NET CAPITAL	2714									1351

TABLE II : PRESENT WORTH - O &amp; M COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	106	106	114	114	114
SLUDGE	(\$1000/YR)	0	0	0	26	26	28	28	28
SEWERS	(\$1000/YR)	0	0	0	13	13	13	13	13
TOTAL	(\$1000/YR)	0	0	0	147	147	156	156	156
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)									
		0	0	0	602	1066	1100	1100	0
PRESENT WORTH (\$1000)									
		0	0	0	250	315	165	84	0
NET O.+M. = 815.363									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2714
O & M (\$1000)	815
LAND (\$1000)	34
TOTAL (\$1000)	3563

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				108	108	108	108	108
PLANT EXPANSION					239	239	239	239
BASIN				19	19	19	19	19
PIPES				201	201	201	201	201
TOTAL O & M	0	0	0	147	147	156	156	156
TOTAL ANNUAL	0	0	0	476	715	725	725	725

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CH-11

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	11	13	16
ANNUAL RUNOFF	0	0	0	0	0	164	197	246
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	410	492	615
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	496						3300			1415
BASIN	30						200			120
PIPES	30						200			120
RESIDUAL	64									
NET CAPITAL	492									TOTAL 1655

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	41	49	61
SLUDGE (\$1000/YR)	0	0	0	0	0	0	10	12	15
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	52	62	77

PRESENT VALUE AT BEGIN-  
NING OF PERIOD (\$1000)

0 0 0 0 0 403 493 0

PRESENT WORTH (\$1000)

0 0 0 0 0 60 37 0

NET O.+M. = 98.3192

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	492
O.+M. (\$1000)	98
LAND (\$1000)	4
TOTAL (\$1000)	594

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						254	254	254
BASIN						14	14	14
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	52	62	77
TOTAL ANNUAL	0	0	0	0	0	335	346	361

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CH-12613

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	3	7	14	20	23
ANNUAL RUNOFF	0	0	0	53	106	209	286	332
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	265	522	715	830
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	946					3200				447
PLANT EXPANSION	206						1370			587
BASIN	56					190				75
BASIN	12						86			51
PIPES	443					1500				599
PIPES	225						1500			900
RESIDUAL	103									TOTAL 2663
NET CAPITAL	1787									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	26	52	71	83
SLUDGE	(\$1000/YR)	0	0	0	0	6	13	17	20
SEWERS	(\$1000/YR)	0	0	0	0	7	14	14	14
TOTAL	(\$1000/YR)	0	0	0	0	40	80	104	118
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	424	648	783	0
PRESENT WORTH (\$1000)		0	0	0	0	125	97	59	0
NET O.+M. =									283.036

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1787
O.+M. (\$1000)	283
LAND (\$1000)	5
TOTAL (\$1000)	2075

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					247	247	247	247
PLANT EXPANSION						105	105	105
BASIN					13	13	13	13
BASIN						6	6	6
PIPES					108	108	108	108
PIPES						108	108	108
TOTAL O.+M.	0	0	0	0	40	80	104	118
TOTAL ANNUAL	0	0	0	0	410	670	694	708

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

LAN A. CH-1661761A

	1972	1975	1980	1985	1990	2000	2010	2020
TORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	4	8	10	13	15
ANNUAL RUNOFF	0	0	0	70	141	181	226	269
LUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	205	264	329	392
TREATMENT PLANT	0	0	0	0	96	110	137	164

REATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

LUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	25					86				12
BASIN	85					290				115
PIPES	1127					3813				1525
RESIDUAL	64									
NET CAPITAL	1174									1653

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
LANT (\$1000/YR)	0	0	0	0	62	80	100	119	
SLUDGE (\$1000/YR)	0	0	0	0	7	10	12	15	
SEWERS (\$1000/YR)	0	0	0	0	19	19	19	19	
TOTAL (\$1000/YR)	0	0	0	0	89	109	131	153	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	698	848	1002	0	
PRESENT WORTH (\$1000)	0	0	0	0	206	127	76	0	
NET O.+M. =	410.853								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1174
O.+M. (\$1000)	410
LAND (\$1000)	11
TOTAL (\$1000)	1596

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					6	6	6	6
BASIN					20	20	20	20
PIPES					276	276	276	276
TOTAL O.+M.	0	0	0	0	89	109	131	153
TOTAL ANNUAL	0	0	0	0	393	413	435	457

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CONS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CH-19

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	2	2	3
ANNUAL RUNOFF	0	0	0	0	0	31	37	46
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	77	92	115
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	225						1500			643
BASIN	13						90			54
PIPES	30						200			120
RESIDUAL	31									
NET CAPITAL	237									TOTAL 817

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	0	7	9	11
SLUDGE	(\$1000/YR)	0	0	0	0	0	1	2	2
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	0	16	12	15
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	0	81	98	0
PRESENT WORTH (\$1000)		0	0	0	0	0	12	7	0
NET O.+M. =	19.7754								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	237
O.+M. (\$1000)	19
LAND (\$1000)	1
TOTAL (\$1000)	258

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						115	115	115
BASIN						6	6	6
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	10	12	15
TOTAL ANNUAL	0	0	0	0	0	147	149	152

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BEARDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

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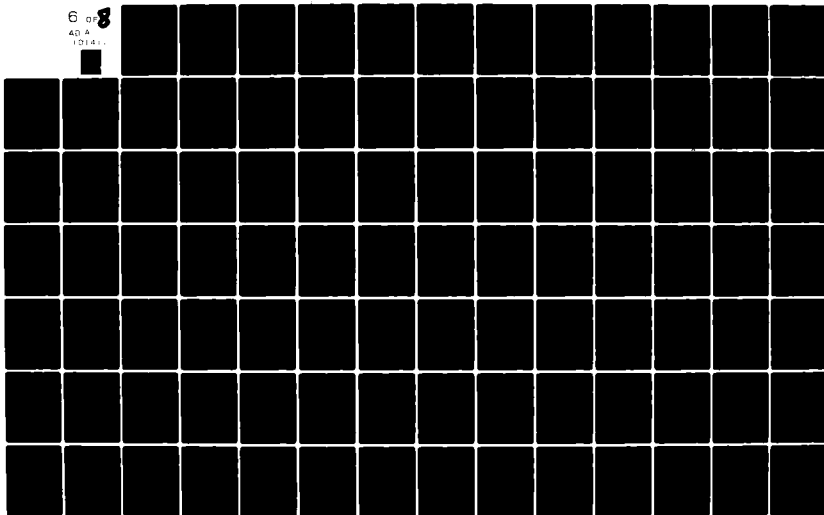
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## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CH-20

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	2	2	3
ANNUAL RUNOFF	0	0	0	0	0	30	36	45
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	75	90	112
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	225						1500			643
BASIN	13						90			54
PIPES	30						200			120
RESIDUAL	31									
NET CAPITAL	237									
									TOTAL	817

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	7	9	11
SLUDGE (\$1000/YR)	0	0	0	0	0	0	1	2	2
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	10	12	13
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	79	95	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	11	7	0
NET O.+M. =	19.2776								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	237
O.+M. (\$1000)	19
LAND (\$1000)	1
TOTAL (\$1000)	257

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						115	115	115
BASIN						6	6	6
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	10	12	13
TOTAL ANNUAL	0	0	0	0	0	147	149	151

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CH-21422

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	3	3	4
ANNUAL RUNOFF	0	0	0	0	0	53	63	79
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	132	157	197
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	278						1850			793
BASIN	16						110			64
PIPES	180						1200			720
RESIDUAL	61									
NET CAPITAL	413									TOTAL 1579

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	13	15	19
SLUDGE (\$1000/YR)	0	0	0	0	0	0	3	3	4
SEWERS (\$1000/YR)	0	0	0	0	0	0	5	5	5
TOTAL (\$1000/YR)	0	0	0	0	0	0	22	25	30
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	169	197	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	25	15	0
NET O.+M. =	40.6093								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	413
O.+M. (\$1000)	40
LAND (\$1000)	1
TOTAL (\$1000)	455

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						142	142	142
BASIN						7	7	7
PIPES						86	86	86
TOTAL O.+M.	0	0	0	0	0	22	25	30
TOTAL ANNUAL	0	0	0	0	0	260	263	268

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CH-23626627

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	4	7	10	21	31	39
ANNUAL RUNOFF	0	29	58	114	170	341	468	595
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	42	84	166	248	497	683	868
TREATMENT PLANT	0	0	35	69	103	208	285	362

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	114			180					180	154
BASIN	145			250						49
BASIN	109					370				147
BASIN	40						270			162
PIPES	1571			2700						539
PIPES	976					3300				1319
PIPES	75						500			300
RESIDUAL	103									TOTAL
NET CAPITAL	2929									2674

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	21	46	75	151	207	263
SLUDGE	(\$1000/YR)	0	0	3	6	9	19	26	33
SEWERS	(\$1000/YR)	0	0	13	13	29	32	32	32
TOTAL	(\$1000/YR)	0	0	38	66	114	202	266	329
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	215	371	1116	1647	2093	0
PRESENT WORTH (\$1000)		0	0	125	154	330	247	159	0
NET O.+M. =	1017.32								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2929
O.+M. (\$1000)	1017
LAND (\$1000)	32
TOTAL (\$1000)	3978

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			13	13	13	13	13	13
BASIN			18	18	18	18	18	18
BASIN					26	26	26	26
BASIN					19	19	19	19
PIPES			195	195	195	195	195	195
PIPES					238	238	238	238
PIPES					36	36	36	36
TOTAL O.+M.	0	0	38	66	114	202	266	329
TOTAL ANNUAL	0	0	265	293	608	751	815	878

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CH-24

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	9	12
ANNUAL RUNOFF	0	0	0	0	0	121	146	182
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	302	365	455
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	436						2900			1244
BASIN	25						170			102
PIPES	30						200			120
RESIDUAL	56									
NET CAPITAL	434									
									TOTAL	1466

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	30	34	45
SLUDGE (\$1000/YR)	0	0	0	0	0	0	7	9	11
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	38	44	57
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	300	366	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	45	28	0
NET O.+M. =	73.1623								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	434
O.+M. (\$1000)	73
LAND (\$1000)	3
TOTAL (\$1000)	511

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						223	223	223
BASIN						12	12	12
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	36	46	57
TOTAL ANNUAL	0	0	0	0	0	289	297	308

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A, CH-25

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	7	8	11
ANNUAL RUNOFF	0	0	0	0	0	105	126	158
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	262	315	395
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000):

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	421						2800			1201
BASIN	25						170			102
PIPES	30						200			120
RESIDUAL	55									
NET CAPITAL	421									
									TOTAL	1423

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	26	31	39
SLUDGE (\$1000/YR)	0	0	0	0	0	0	6	7	9
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	33	40	50
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	260	318	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	39	24	0
NET O.+M. =	63.5314								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	421
O.+M. (\$1000)	63
LAND (\$1000)	3
TOTAL (\$1000)	488

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						216	216	216
BASIN						12	12	12
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	33	40	50
TOTAL ANNUAL	0	0	0	0	0	276	283	293

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## COMPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CN-28

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	6	8	10
ANNUAL RUNOFF	0	0	0	0	0	95	113	141
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	138	164	205
TREATMENT PLANT	0	0	0	0	0	57	68	86

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	6						45			19
BASIN	24						160			96
PIPES	45						300			180
RESIDUAL	11									
NET CAPITAL	64									
									TOTAL	295

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	0	40	47	59
SLUDGE	(\$1000/YR)	0	0	0	0	0	4	5	6
SEWERS	(\$1000/YR)	0	0	0	0	0	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	0	45	54	67
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	0	351	427	0
PRESENT WORTH (\$1000)		0	0	0	0	0	52	32	0
NET O.+M. =		85.5948							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	64
O.+M. (\$1000)	85
LAND (\$1000)	2
TOTAL (\$1000)	152

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING						3	3	3
BASIN						11	11	11
PIPES						21	21	21
TOTAL O.+M.	0	0	0	0	0	45	54	67
TOTAL ANNUAL	0	0	0	0	0	82	91	104

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A , CH-29

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	1	3
ANNUAL RUNOFF	0	0	0	0	0	28	34	43
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	70	85	107
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	225						1500			643
BASIN	13						90			54
PIPES	30						200			120
RESIDUAL	31									
NET CAPITAL	237									817

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)		0	0	0	0	0	7	8	10
SLUDGE (\$1000/YR)		0	0	0	0	0	1	2	2
SEWERS (\$1000/YR)		0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)		0	0	0	0	0	9	11	14
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	0	75	91	0
PRESENT WORTH (\$1000)		0	0	0	0	0	11	6	0
NET O.+M. =	18.2821								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	237
O.+M. (\$1000)	28
LAND (\$1000)	1
TOTAL (\$1000)	256

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						115	115	115
BASIN						6	6	6
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	9	11	14
TOTAL ANNUAL	0	0	0	0	0	146	148	151

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CH-30&amp;32N

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	1	11	11	11
ANNUAL RUNOFF	0	0	0	6	12	158	164	174
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	17	230	239	254
TREATMENT PLANT	0	0	0	0	7	96	100	106

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000):

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	17					58				8
BASIN	70					240				95
PIPES	369					1250				499
PIPES	165						1100			660
RESIDUAL	49									
NET CAPITAL	574									
									TOTAL	1264

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>
PLANT	(\$1000/YR)	0	0	0	0	5	72	75	79
SLUDGE	(\$1000/YR)	0	0	0	0	0	9	9	10
SEWERS	(\$1000/YR)	0	0	0	0	6	11	11	11
<u>        </u>		<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>
TOTAL	(\$1000/YR)	0	0	0	0	12	93	96	101
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	371	665	694	0
PRESENT WORTH (\$1000)		0	0	0	0	109	100	53	0
NET O.+M. =	263.02								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	574
O.+M. (\$1000)	263
LAND (\$1000)	3
TOTAL (\$1000)	840

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					4	4	4	4
BASIN					17	17	17	17
PIPES					90	90	90	90
PIPES					79	79	79	79
TOTAL O.+M.	0	0	0	0	12	93	96	101
TOTAL ANNUAL	0	0	0	0	124	285	288	293

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A . CH-31

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	4	6	7
ANNUAL RUNOFF	0	0	0	0	0	68	83	103
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	170	207	257
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	330						2200			943
BASIN	19						130			78
PIPES	30						200			120
RESIDUAL	44									
NET CAPITAL	336									
									TOTAL	1141

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	17	20	25
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	5	6
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	22	26	33
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	172	211	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	25	16	0
NET O.+M. =	42.1106								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	336
O.+M. (\$1000)	42
LAND (\$1000)	2
TOTAL (\$1000)	380

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						169	169	169
BASIN						9	9	9
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	22	26	33
TOTAL ANNUAL	0	0	0	0	0	215	220	226

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CH-325833

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	1	13	14	14
ANNUAL RUNOFF	0	0	0	13	26	183	194	205
SLUDGE QUANTITIES (DT/YR):								
SEDIMENT BASIN	0	0	0	0	63	457	485	512
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	443					1500				209
PLANT EXPANSION	187						1250			536
BASIN	25					85				33
BASIN	11						74			44
PIPES	331					1120				447
PIPES	33						220			132
RESIDUAL	54									TOTAL 1404
NET CAPITAL	977									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	6	45	48	51
SLUDGE	(\$1000/YR)	0	0	0	0	1	11	12	12
SEWERS	(\$1000/YR)	0	0	0	0	5	6	6	6
TOTAL	(\$1000/YR)	0	0	0	0	13	63	67	70
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	272	460	484	0
PRESENT WORTH (\$1000)		0	0	0	0	80	69	37	0
NET O.+M. =	186.973								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	977
O.+M. (\$1000)	186
LAND (\$1000)	2
TOTAL (\$1000)	1166

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					115	115	115	115
PLANT EXPANSION						96	96	96
BASIN					6	6	6	6
BASIN						5	5	5
PIPES					81	81	81	81
PIPES						15	15	15
TOTAL O.+M.	0	0	0	0	13	63	67	70
TOTAL ANNUAL	0	0	0	0	216	384	388	391

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS.

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CH-34

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	2	3
ANNUAL RUNOFF	0	0	0	0	0	34	40	51
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	85	100	127
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	233						1550			664
BASIN	13						90			54
PIPES	30						200			120
RESIDUAL	32									
NET CAPITAL	244									
									TOTAL	838

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	8	10	12
SLUDGE (\$1000/YR)	0	0	0	0	0	0	2	2	3
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	11	13	16
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	88	106	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	13	8	0
NET O.+M. =	21.4365								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	244
O.+M. (\$1000)	21
LAND (\$1000)	1
TOTAL (\$1000)	266

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						119	119	119
BASIN						6	6	6
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	11	13	16
TOTAL ANNUAL	0	0	0	0	0	152	154	157

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CH-35

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	4	5	6	9
ANNUAL RUNOFF	0	0	0	29	59	71	88	118
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	147	177	220	295
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	680					2300				321
BASIN	41					140				55
PIPES	59					200				79
RESIDUAL	17									
NET CAPITAL	763									457

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	14	17	22	29
SLUDGE	(\$1000/YR)	0	0	0	0	3	4	5	7
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	19	23	28	37
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	149	181	233	0
PRESENT WORTH	(\$1000)	0	0	0	0	44	27	17	0
NET O.+M. =		89.3856							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	763
O.+M. (\$1000)	89
LAND (\$1000)	2
TOTAL (\$1000)	854

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					177	177	177	177
BASIN					10	10	10	10
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	19	23	28	37
TOTAL ANNUAL	0	0	0	0	221	225	230	240

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CH-36

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	9	11
ANNUAL RUNOFF	0	0	0	0	0	111	133	166
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	277	332	415
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	428						2850			1222
BASIN	25						170			102
PIPES	105						700			420
RESIDUAL	67									
NET CAPITAL	491									
									TOTAL	1744

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	27	33	41
SLUDGE (\$1000/YR)	0	0	0	0	0	0	6	8	10
SEWERS (\$1000/YR)	0	0	0	0	0	0	3	3	3
TOTAL (\$1000/YR)	0	0	0	0	0	0	38	45	55
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	292	352	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	43	26	0
NET O.+M. =	70.917								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	491
O.+M. (\$1000)	70
LAND (\$1000)	3
TOTAL (\$1000)	565

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						220	220	220
BASIN						12	12	12
PIPES						50	50	50
TOTAL O.+M.	0	0	0	0	0	38	45	55
TOTAL ANNUAL	0	0	0	0	0	321	328	338

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, R-1-4-5

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	14	29	29	29	30	30	30
ANNUAL RUNOFF	0	262	524	524	524	579	579	579
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	382	765	765	765	845	845	845
TREATMENT PLANT	0	0	319	319	319	353	353	353

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	208			328					328	281
BASIN	4976			8550						1709
PIPES	407			700						139
RESIDUAL	82									
NET CAPITAL	5509									
									TOTAL	2131

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	156	156	156	172	172	172	172
SLUDGE (\$1000/YR)	0	0	32	32	32	35	35	35	35
SEWERS (\$1000/YR)	0	0	3	3	3	3	3	3	3
TOTAL (\$1000/YR)	0	0	192	192	192	211	211	211	211
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	788	788	1419	1488	1488	0	0
PRESENT WORTH (\$1000)	0	0	458	326	419	223	113	0	0
NET O.+M. =	1543.12								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	5509
O.+M. (\$1000)	1543
LAND (\$1000)	20
TOTAL (\$1000)	7072

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			25	25	25	25	25	25
BASIN			619	619	619	619	619	619
PIPES			50	50	50	50	50	50
TOTAL O.+M.	0	0	192	192	192	211	211	211
TOTAL ANNUAL	0	0	887	887	887	907	907	907

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, R-3

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	11	22	22	23	23	24	24
ANNUAL RUNOFF	0	160	321	325	330	352	385	385
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	300	601	610	825	880	962	962
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	7638			12000					12000	10283
SLUDGE HANDLING	265			417					417	357
BASIN	3233			5555						1110
PIPES	116			200						39
RESIDUAL	457									
NET CAPITAL	10795									11792

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	19	57	95	102	111	111	111
SLUDGE (\$1000/YR)	0	0	12	12	16	17	19	19	19
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	33	70	113	120	131	131	131
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	213	377	821	886	926	926	0
PRESENT WORTH (\$1000)	0	0	124	156	242	133	70	70	0
NET O.+M. =	728.125								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	10795
O.+M. (\$1000)	728
LAND (\$1000)	42
TOTAL (\$1000)	11565

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			926	926	926	926	926	926
SLUDGE HANDLING			32	32	32	32	32	32
BASIN			402	402	402	402	402	402
PIPES			14	14	14	14	14	14
TOTAL O.+M.	0	0	33	70	113	120	131	131
TOTAL ANNUAL	0	0	1408	1446	1488	1495	1507	1507

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, R-6-T-8N

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	28	56	62	69	74	78	78
ANNUAL RUNOFF	0	384	769	862	955	1027	1098	1098
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	720	1441	1616	2387	2567	2745	2745
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1209			1900					1900	1628
PLANT EXPANSION	1327				3200					0
BASIN	209			360						71
BASIN	83				202					60
PIPES	6776			11644						2328
RESIDUAL	158								TOTAL	4089
NET CAPITAL	9448									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	26	122	238	256	274	274
SLUDGE	(\$1000/YR)	0	0	36	40	59	64	68	68
SEWERS	(\$1000/YR)	0	0	58	58	58	58	58	58
TOTAL	(\$1000/YR)	0	0	121	221	356	379	401	401
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	702	1185	2583	2740	2818	0
PRESENT WORTH (\$1000)		0	0	408	491	764	412	215	0
NET O.+M. =	2292.49								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	9448
O.+M. (\$1000)	2292
LAND (\$1000)	77
TOTAL (\$1000)	11817

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			146	146	146	146	146	146
PLANT EXPANSION				247	247	247	247	247
BASIN			26	26	26	26	26	26
BASIN				14	14	14	14	14
PIPES			843	843	843	843	843	843
TOTAL O.+M.	0	0	121	221	356	379	401	401
TOTAL ANNUAL	0	0	1136	1498	1634	1656	1678	1678

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - R-85-11-19

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	3	6	12	18	71	76	79
ANNUAL RUNOFF	0	32	65	152	240	984	1054	1112
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	60	121	285	600	2460	2635	2780
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	490			770					770	459
PLANT EXPANSION	1541					5210				729
PLANT EXPANSION	258						1720			737
BASIN	93			160						31
BASIN	63					216				86
BASIN	17						116			69
PIPES	650					2200				879
RESIDUAL	123									
NET CAPITAL	2991									3195

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	2	21	60	246	263	278
SLUDGE	(\$1000/YR)	0	0	3	7	15	61	65	69
SEWERS	(\$1000/YR)	0	0	0	0	10	10	10	10
TOTAL	(\$1000/YR)	0	0	5	28	85	318	340	358
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	70	235	1420	2313	2454	0
PRESENT WORTH (\$1000)		0	0	40	97	420	347	187	0
NET O.+M. =	1094.21								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2991
O.+M. (\$1000)	1094
LAND (\$1000)	30
TOTAL (\$1000)	4115

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			59	59	59	59	59	59
PLANT EXPANSION					402	402	402	402
PLANT EXPANSION						132	132	132
BASIN			11	11	11	11	11	11
BASIN					15	15	15	15
BASIN						8	8	8
PIPES					159	159	159	159
TOTAL O.+M.	0	0	5	28	85	318	340	358
TOTAL ANNUAL	0	0	76	99	734	1107	1129	1147

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A , R-9

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	2	2	2	2	2	2	2	2
ANNUAL RUNOFF	38	39	41	41	41	41	41	41
SLUDGE QUANTITIES (DT/YR):								
SEDIMENT BASIN	22	23	23	23	23	23	23	23
TREATMENT PLANT	8	9	9	9	9	9	9	9

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	6		7					7		4
BASIN	465		570							57
PIPES	163		200							20
RESIDUAL	3									
NET CAPITAL	631									81

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	7	8	9	11	11	11	11	11
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	8	9	10	12	12	12	12	12
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	37	41	47	86	86	86	86	0
PRESENT WORTH (\$1000)	0	30	23	19	25	13	6	0	0
NET O.+M. =	119.442								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	631
O.+M. (\$1000)	119
LAND (\$1000)	12
TOTAL (\$1000)	762

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING		0	0	0	0	0	0	0
BASIN		41	41	41	41	41	41	41
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	8	9	10	12	12	12	12
TOTAL ANNUAL	0	65	65	67	68	68	68	68

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SLUPE STUDY

## PLAN A, R-10

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	30	60	60	61	63	67	69
ANNUAL RUNOFF	0	406	813	825	838	877	941	979
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	762	1524	1547	2095	2192	2352	2447
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1336			2100					2100	1799
PLANT EXPANSION	1360					4600				643
BASIN	232			400						79
PIPES	116			200						39
RESIDUAL	99								TOTAL	2563
NET CAPITAL	2947									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	28	117	209	219	235	244
SLUDGE (\$1000/YR)	0	0	0	38	38	52	54	58	61
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	67	157	262	275	295	306
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	461	861	1889	2002	2114	0
PRESENT WORTH (\$1000)	0	0	0	268	357	558	301	161	0
NET O.+M. =	1647.17								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2947
O.+M. (\$1000)	1647
LAND (\$1000)	74
TOTAL (\$1000)	4668

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			162	162	162	162	162	162
PLANT EXPANSION					355	355	355	355
BASIN			28	28	28	28	28	28
PIPES			14	14	14	14	14	14
TOTAL O.+M.	0	0	67	157	262	275	295	306
TOTAL ANNUAL	0	0	273	362	823	835	855	867

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, R-12

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	11	22	33	45	56
ANNUAL RUNOFF	0	0	0	164	328	494	658	823
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	820	1235	1645	2057
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1626					5500				769
BASIN	109					370				147
PIPES	485					1640				655
RESIDUAL	61									
NET CAPITAL	2160									TOTAL 1573

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	82	123	164	205
SLUDGE	(\$1000/YR)	0	0	0	0	20	30	41	51
SEWERS	(\$1000/YR)	0	0	0	0	8	8	8	8
TOTAL	(\$1000/YR)	0	0	0	0	110	162	213	263
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	959	1321	1682	0
PRESENT WORTH (\$1000)		0	0	0	0	283	198	128	0
NET O.+M. =	611.245								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2160
O.+M. (\$1000)	611
LAND (\$1000)	64
TOTAL (\$1000)	2835

TABLE IV : ANNUAL COSTS (\$1000/YR) :

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					424	424	424	424
BASIN					26	26	26	26
PIPES					118	118	118	118
TOTAL O.+M.	0	0	0	0	110	162	213	263
TOTAL ANNUAL	0	0	0	0	680	732	783	835

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, R-13

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	34	69	71	74	78	82	82
ANNUAL RUNOFF	0	471	944	980	1017	1091	1167	1167
SLUDGE QUANTITIES (CY/YR)								
SEDIMENT BASIN	0	884	1768	1837	2542	2727	2917	2917
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1400			2200					2200	1885
PLANT EXPANSION	1478					5000				699
BASIN	256			440						87
RESIDUAL	103									
NET CAPITAL	3031								TOTAL	2673

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	33	139	254	272	291	291
SLUDGE	(\$1000/YR)	0	0	44	45	63	68	72	72
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	77	185	317	340	364	364
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	538	1031	2313	2477	2561	0
PRESENT WORTH (\$1000)		0	0	313	428	684	372	195	0
NET O.+M. =		1994.39							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3031
O.+M. (\$1000)	1994
LAND (\$1000)	88
TOTAL (\$1000)	5114

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			169	169	169	169	169	169
PLANT EXPANSION					385	385	385	385
BASIN			31	31	31	31	31	31
TOTAL O.+M.	0	0	77	185	317	340	364	364
TOTAL ANNUAL	0	0	278	387	905	928	952	952

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, R-14821

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	1	3	5	9	10
ANNUAL RUNOFF	0	0	0	35	71	108	144	179
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	177	270	360	447
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	857					2900				405
BASIN	50					170				67
PIPES	414					1400				559
RESIDUAL	40									
NET CAPITAL	1282									TOTAL 1038

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	17	27	36	44
SLUDGE	(\$1000/YR)	0	0	0	0	4	6	9	11
SEWERS	(\$1000/YR)	0	0	0	0	6	6	6	6
TOTAL	(\$1000/YR)	0	0	0	0	29	40	51	62
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	245	325	403	0
PRESENT WORTH (\$1000)		0	0	0	0	72	48	30	0
NET O.+M. =	152.474								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1282
O.+M. (\$1000)	152
LAND (\$1000)	3
TOTAL (\$1000)	1437

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					223	223	223	223
BASIN					12	12	12	12
PIPES					101	101	101	101
TOTAL O.+M.	0	0	0	0	29	40	51	62
TOTAL ANNUAL	0	0	0	0	344	378	389	400

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, R-15622

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	5	10	13	18	22
ANNUAL RUNOFF	0	0	0	68	136	204	273	341
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	340	510	682	852
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1094					3700				517
BASIN	68					230				91
PIPES	709					2400				959
RESIDUAL	60									
NET CAPITAL	1811									TOTAL 1569

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	34	51	68	85	
SLUDGE (\$1000/YR)	0	0	0	0	8	12	17	21	
SEWERS (\$1000/YR)	0	0	0	0	11	11	11	11	
TOTAL (\$1000/YR)	0	0	0	0	54	75	97	118	

PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)

0 0 0 0 457 607 758 0

PRESENT WORTH (\$1000)

0 0 0 0 135 91 57 0

NET O.+M. = 284.625

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1811
O.+M. (\$1000)	284
LAND (\$1000)	5
TOTAL (\$1000)	2101

TABLE IV : ANNUAL COSTS (\$1000/YR) :

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					285	285	285	285
BASIN					16	16	16	16
PIPES					173	173	173	173
TOTAL O.+M.	0	0	0	0	54	75	97	118
TOTAL ANNUAL	0	0	0	0	530	551	573	594

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, R-16617

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	15	31	32	33	33	34	34
ANNUAL RUNOFF	0	217	434	444	455	476	510	510
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	542	1085	1111	1137	1190	1275	1275
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL :
TREATMENT PLANT	1867				4500					0
BASIN	116				280					84
PIPES	672				1620					486
RESIDUAL	22									
NET CAPITAL	2633									TOTAL 570

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	113	113	119	127	127
SLUDGE	(\$1000/YR)	0	0	0	28	28	29	31	31
SEWERS	(\$1000/YR)	0	0	0	8	8	8	8	8
TOTAL	(\$1000/YR)	0	0	0	150	150	156	167	167
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	616	1078	1138	1176	0
PRESENT WORTH	(\$1000)	0	0	0	255	319	171	89	0
NET O.+M. = 835.869									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2633
O.+M. (\$1000)	835
LAND (\$1000)	8
TOTAL (\$1000)	3477

TABLE IV : ANNUAL COSTS (\$1000/YR) :

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				347	347	347	347	347
BASIN				20	20	20	20	20
PIPES				117	117	117	117	117
TOTAL O.+M.	0	0	0	150	150	156	167	167
TOTAL ANNUAL	0	0	0	635	635	641	652	652

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A , R-18

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	5	10	15	21	26
ANNUAL RUNOFF	0	0	0	76	152	228	304	381
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	380	570	760	952
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1183					4000				559
BASIN	73					250				99
PIPES	59					200				79
RESIDUAL	28									
NET CAPITAL	1287									739

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	38	57	76	95
SLUDGE	(\$1000/YR)	0	0	0	0	9	14	19	23
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	48	72	95	120
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	424	590	758	0
PRESENT WORTH (\$1000)									
		0	0	0	0	125	88	57	0
NET O.+M. = 272.265									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1287
O.+M. (\$1000)	272
LAND (\$1000)	6
TOTAL (\$1000)	1565

TABLE IV : ANNUAL COSTS (\$1000/YR) :

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					308	308	308	308
BASIN					18	18	18	18
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	48	72	95	120
TOTAL ANNUAL	0	0	0	0	389	413	437	441

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A . R-20

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	6	12	14	19	25
ANNUAL RUNOFF	0	0	0	92	184	220	275	368
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	460	550	687	920
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1715					5800				811
BASIN	56					190				75
PIPES	1156					3909				1563
RESIDUAL	95									
NET CAPITAL	2833									
									TOTAL	2451

TABLE II : PRESENT WORTH - O.+M. COSTS

		<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
PLANT	(\$1000/YR)	0	0	0	0	46	55	68	92
SLUDGE	(\$1000/YR)	0	0	0	0	11	13	17	23
SEWERS	(\$1000/YR)	0	0	0	0	19	19	19	19
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>77</u>	<u>88</u>	<u>105</u>	<u>134</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	580	680	842	0
PRESENT WORTH (\$1000)		0	0	0	0	171	102	64	0
NET O.+M. =		338.497							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2833
O.+M. (\$1000)	338
LAND (\$1000)	6
TOTAL (\$1000)	3177

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					447	447	447	447
BASIN					13	13	13	13
PIPES					283	283	283	283
TOTAL O.+M.	0	0	0	0	77	88	105	134
TOTAL ANNUAL	0	0	0	0	821	832	850	879

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, R-23625N

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	7	15	28	35	42
ANNUAL RUNOFF	0	0	0	113	227	426	512	665
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	331	621	747	970
TREATMENT PLANT	0	0	0	0	138	259	312	405

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	39					135				18
BASIN	136					460				183
BASIN	31						210			126
PIPES	158					535				213
PIPES	75						500			300
RESIDUAL	32									
NET CAPITAL	408									TOTAL 842

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	71	133	160	208
SLUDGE	(\$1000/YR)	0	0	0	0	11	20	24	32
SEWERS	(\$1000/YR)	0	0	0	0	2	5	5	5
TOTAL	(\$1000/YR)	0	0	0	0	84	159	190	245
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	857	1227	1531	0
PRESENT WORTH (\$1000)									
		0	0	0	0	253	184	116	0
NET O.+M. =		555.159							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	408
O.+M. (\$1000)	555
LAND (\$1000)	10
TOTAL (\$1000)	973

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					10	10	10	10
BASIN					33	33	33	33
BASIN						15	15	15
PIPES					38	38	38	38
PIPES						36	36	36
TOTAL O.+M.	0	0	0	0	84	159	190	245
TOTAL ANNUAL	0	0	0	0	167	293	324	379

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## ORRPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - R-24

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	4	9	14	19	23
ANNUAL RUNOFF	0	0	0	68	137	206	275	345
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	342	515	687	862
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1094					3700				517
BASIN	68					230				91
PIPES	59					200				79
RESIDUAL	26									
NET CAPITAL	1194									889

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	34	51	68	86
SLUDGE	(\$1000/YR)	0	0	0	0	8	12	17	21
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	43	63	86	108
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	383	534	687	0
PRESENT WORTH (\$1000)									
		0	0	0	0	113	80	52	0
NET O.+M. =		246.387							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1194
O.+M. (\$1000)	246
LAND (\$1000)	5
TOTAL (\$1000)	1446

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					285	285	285	285
BASIN					16	16	16	16
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	43	63	86	108
TOTAL ANNUAL	0	0	0	0	340	382	403	425

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A , R-255&amp;26

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	7	10
ANNUAL RUNOFF	0	0	0	0	0	88	123	150
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	122	179	219
TREATMENT PLANT	0	0	0	0	0	53	75	91

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000).

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	4						31			13
BASIN	31						210			126
PIPES	300						2000			1200
RESIDUAL	51									
NET CAPITAL	285									
									TOTAL	1339

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	27	38	46
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	5	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	9	9	9
TOTAL (\$1000/YR)	0	0	0	0	0	0	41	54	64
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	338	416	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	50	31	0
NET O.+M. =	82.731								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	285
O.+M. (\$1000)	82
LAND (\$1000)	2
TOTAL (\$1000)	369

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING						2	2	2
BASIN						15	15	15
PIPES						144	144	144
TOTAL O.+M.	0	0	0	0	0	41	54	64
TOTAL ANNUAL	0	0	0	0	0	204	216	226

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - R-27

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	3	7	11	13	14
ANNUAL RUNOFF	0	0	0	54	109	164	203	217
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	159	239	294	316
TREATMENT PLANT	0	0	0	0	64	100	123	132

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	13					44				6
BASIN	73					250				99
PIPES	88					300				119
RESIDUAL	8									
NET CAPITAL	164									226

TABLE II : PRESENT WORTH - O &amp; M COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	34	51	63	67	
SLUDGE (\$1000/YR)	0	0	0	0	5	7	9	10	
SEWERS (\$1000/YR)	0	0	0	0	1	1	1	1	
TOTAL (\$1000/YR)	0	0	0	0	40	60	74	79	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	357	476	544	0	
PRESENT WORTH (\$1000)	0	0	0	0	105	71	41	0	
NET O & M =	218.948								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	164
O & M (\$1000)	218
LAND (\$1000)	3
TOTAL (\$1000)	388

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					3	3	3	3
BASIN					18	18	18	18
PIPES					21	21	21	21
TOTAL O & M	0	0	0	0	40	60	74	79
TOTAL ANNUAL	0	0	0	0	84	104	118	123

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, R-20

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	37	49	62
ANNUAL RUNOFF	0	0	0	0	0	537	716	895
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	1342	1790	2237
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	872						5800			2488
BASIN	58						390			234
PIPES	30						200			120
RESIDUAL	110									
NET CAPITAL	850									TOTAL 2842

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	134	179	223
SLUDGE (\$1000/YR)	0	0	0	0	0	0	33	44	55
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	168	224	280
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	1382	1774	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	207	135	0
NET O.+M. =	343.474								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	850
O.+M. (\$1000)	343
LAND (\$1000)	14
TOTAL (\$1000)	1208

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						447	447	447
BASIN						28	28	28
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	168	224	280
TOTAL ANNUAL	0	0	0	0	0	659	715	771

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A, R-29

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	10	11
ANNUAL RUNOFF	0	0	0	0	0	112	135	168
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	210	253	315
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	79						530			227
BASIN	33						225			135
PIPES	170						1136			481
RESIDUAL	40									
NET CAPITAL	243									TOTAL 1043

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	4	5
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	4	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	5	5	5
TOTAL (\$1000/YR)	0	0	0	0	0	0	14	16	19
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	110	127	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	16	9	0
NET O.+M. =	26.385								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	243
O.+M. (\$1000)	26
LAND (\$1000)	3
TOTAL (\$1000)	273

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						40	40	40
BASIN						16	16	16
PIPES						82	82	82
TOTAL O.+M.	0	0	0	0	0	14	16	19
TOTAL ANNUAL	0	0	0	0	0	154	156	158

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A. R-3068E 33

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	8	9
ANNUAL RUNOFF	0	0	0	0	0	67	91	121
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	167	227	302
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	391						2600			1115
BASIN	22						150			90
PIPES	119						797			478
RESIDUAL	65									
NET CAPITAL	468									
									TOTAL	1683

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	16	22	30
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	5	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	3	3	3
TOTAL (\$1000/YR)	0	0	0	0	0	0	24	32	41
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	201	260	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	30	19	0
NET O.+M. =	50.2007								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	468
O.+M. (\$1000)	50
LAND (\$1000)	2
TOTAL (\$1000)	520

TABLE IV : ANNUAL COSTS (\$1000/YR) :

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						200	200	200
BASIN						10	10	10
PIPES						57	57	57
TOTAL O.+M.	0	0	0	0	0	24	32	41
TOTAL ANNUAL	0	0	0	0	0	294	301	311

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, R-31

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	3	4
ANNUAL RUNOFF	0	0	0	0	0	34	51	70
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	85	127	175
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	195						1300			557
BASIN	10						70			42
PIPES	30						200			120
RESIDUAL	27									
NET CAPITAL	208									
									TOTAL	719

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	8	12	17
SLUDGE (\$1000/YR)	0	0	0	0	0	0	2	3	4
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	11	16	22
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	100	139	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	15	10	0
NET O.+M. =	25.7673								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	208
O.+M. (\$1000)	25
LAND (\$1000)	1
TOTAL (\$1000)	234

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						100	100	100
BASIN						5	5	5
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	11	16	22
TOTAL ANNUAL	0	0	0	0	0	131	136	142

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, R-32

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	4	9	14	19	21
ANNUAL RUNOFF	0	0	0	68	137	206	274	302
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	515	685	755
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1005					3400				475
BASIN	62					210				83
PIPES	562					1900				759
RESIDUAL	51									
NET CAPITAL	1578									TOTAL 1319

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	51	68	75
SLUDGE (\$1000/YR)	0	0	0	0	0	0	12	17	18
SEWERS (\$1000/YR)	0	0	0	0	0	9	9	9	9
TOTAL (\$1000/YR)	0	0	0	0	0	9	73	95	103
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	292	593	698	0	0
PRESENT WORTH (\$1000)	0	0	0	0	86	89	53	0	0
NET O.+M. =	229.259								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1578
O.+M. (\$1000)	229
LAND (\$1000)	20
TOTAL (\$1000)	1827

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					262	262	262	262
BASIN					15	15	15	15
PIPES					137	137	137	137
TOTAL O.+M.	0	0	0	0	9	73	95	103
TOTAL ANNUAL	0	0	0	0	424	489	510	519

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, R-34

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	4	5	7	9	11	11
ANNUAL RUNOFF	0	34	69	84	104	139	153	174
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	84	172	214	260	347	382	438
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1327				3200					0
BASIN	78				190					57
PIPES	82				200					60
RESIDUAL	4									
NET CAPITAL	1484									117

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	26	26	34	38	43
SLUDGE	(\$1000/YR)	0	0	0	6	6	8	9	10
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	33	33	44	48	53
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	137	273	327	365	0
PRESENT WORTH (\$1000)									
		0	0	0	56	80	49	27	0
NET O.+M. = 215.152									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1484
O.+M. (\$1000)	215
LAND (\$1000)	17
TOTAL (\$1000)	1717

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				247	247	247	247	247
BASIN				13	13	13	13	13
PIPES				14	14	14	14	14
TOTAL O.+M.	0	0	0	33	33	44	48	53
TOTAL ANNUAL	0	0	0	308	308	319	324	330

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, R-35

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	3	7	9	12	16	17	20
ANNUAL RUNOFF	0	60	120	150	180	240	264	300
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	150	300	375	450	600	660	750
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1493				3600					0
BASIN	91				220					66
PIPES	82				200					60
RESIDUAL	4									
NET CAPITAL	1663									TOTAL 126

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	45	45	60	66	75
SLUDGE	(\$1000/YR)	0	0	0	11	11	15	16	18
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	57	57	75	83	94
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	234	467	560	625	0
PRESENT WORTH (\$1000)		0	0	0	97	138	84	47	0
NET O.+M. =	367.873								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1663
O.+M. (\$1000)	367
LAND (\$1000)	22
TOTAL (\$1000)	2052

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				277	277	277	277	277
BASIN				15	15	15	15	15
PIPES				14	14	14	14	14
TOTAL O.+M.	0	0	0	57	57	75	83	94
TOTAL ANNUAL	0	0	0	365	365	384	391	403

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, LE-1

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	24	48	49	50	53	55	55
ANNUAL RUNOFF	0	340	681	738	795	909	1022	1022
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	638	1276	1383	1987	2272	2555	2555
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	4137			6500					6500	5570
PLANT EXPANSION	3993					13500				1889
SLUDGE HANDLING	339			534					534	457
BASIN	5529			9500						1899
PIPES	2037			3500						699
RESIDUAL	408								TOTAL	10518
NET CAPITAL	15628									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	42	129	230	263	296	296
SLUDGE	(\$1000/YR)	0	0	8	9	13	15	17	17
SEWERS	(\$1000/YR)	0	0	17	17	17	17	17	17
TOTAL	(\$1000/YR)	0	0	68	157	261	297	331	331
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		0	0	462	859	1962	2208	2330	0
PRESENT WORTH (\$1000)		0	0	269	356	580	332	178	0
NET O.+M. =									1716.53

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	15628
O.+M. (\$1000)	1716
LAND (\$1000)	20

TOTAL (\$1000) 17364

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			501	501	501	501	501	501
PLANT EXPANSION					1042	1042	1042	1042
SLUDGE HANDLING			41	41	41	41	41	41
BASIN			687	687	687	687	687	687
PIPES			253	253	253	253	253	253
TOTAL O.+M.	0	0	68	157	261	297	331	331
TOTAL ANNUAL	0	0	1552	1641	2788	2823	2858	2858

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, LE-2

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	18	37	38	39	41	41	41
ANNUAL RUNOFF	0	294	589	631	673	757	757	757
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	552	1104	1183	1682	1892	1892	1892
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	3819			6000					6000	5141
PLANT EXPANSION	3697					12500				1749
SLUDGE HANDLING	273			429					429	367
BASIN	4621			7940						1587
PIPES	2153			3700						739
RESIDUAL	372								TOTAL	9587
NET CAPITAL	14192									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	36	111	195	219	219	219
SLUDGE	(\$1000/YR)	0	0	7	7	10	11	11	11
SEWERS	(\$1000/YR)	0	0	18	18	18	18	18	18
TOTAL	(\$1000/YR)	0	0	62	137	223	249	249	249
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)									
		0	0	409	740	1661	1751	1751	0
PRESENT WORTH (\$1000)									
		0	0	238	307	491	263	133	0
NET O.+M. =		1434.43							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	14192
O.+M. (\$1000)	1434
LAND (\$1000)	20
TOTAL (\$1000)	15646

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			463	463	463	463	463	463
PLANT EXPANSION					964	964	964	964
SLUDGE HANDLING			33	33	33	33	33	33
BASIN			574	574	574	574	574	574
PIPES			267	267	267	267	267	267
TOTAL O.+M.	0	0	42	137	223	249	249	249
TOTAL ANNUAL	0	0	1401	1476	2527	2553	2553	2553

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, LE-3

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	33	67	68	70	73	73	73
ANNUAL RUNOFF	0	525	1050	1125	1200	1350	1350	1350
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	766	1533	1642	1752	1971	1971	1971
TREATMENT PLANT	0	0	640	686	732	823	823	823

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	439			690					690	591
BASIN	12105			20800						4159
PIPES	2211			3800						759
RESIDUAL	213								TOTAL	5511
NET CAPITAL	14542									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	276	324	375	422	422	422
SLUDGE	(\$1000/YR)	0	0	14	14	14	16	16	16
SEWERS	(\$1000/YR)	0	0	18	18	18	18	18	18
TOTAL	(\$1000/YR)	0	0	309	357	409	458	458	458
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)									
		0	0	1367	1572	3047	3218	3218	0
PRESENT WORTH (\$1000)									
		0	0	796	652	901	484	245	0
NET O.+M. =		3080.08							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	14542
O.+M. (\$1000)	3080
LAND (\$1000)	30

TOTAL (\$1000) 17652

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			53	53	53	53	53	53
BASIN			1505	1505	1505	1505	1505	1505
PIPES			275	275	275	275	275	275
TOTAL O.+M.	0	0	309	357	409	458	458	458
TOTAL ANNUAL	0	0	2143	2191	2243	2292	2292	2292

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CUMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, 4E-4

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	81	162	166	171	179	188	197
ANNUAL RUNOFF	0	1118	2237	2325	2414	2816	3219	3021
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	1633	3266	3395	3524	4111	4699	5286
TREATMENT PLANT	0	0	1364	1418	1472	1717	1963	2208

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	1050			1650					1650	1414
BASIN	32708			56200						11239
PIPES	494			850						169
RESIDUAL	497								TOTAL	12824
NET CAPITAL	33755									

TABLE II : PRESENT WORTH - C.O.M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	498	617	743	867	991	1115
SLUDGE	(\$1000/YR)	0	0	23	24	24	29	33	37
SEWERS	(\$1000/YR)	0	0	4	4	4	4	4	4
TOTAL	(\$1000/YR)	0	0	526	645	772	900	1029	1156
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	2402	2907	5876	6776	7676	0
PRESENT WORTH (\$1000)		0	0	1398	1206	1738	1019	586	0
NET C.O.M. =	5948.93								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	33755
C.O.M. (\$1000)	5948
LAND (\$1000)	50
TOTAL (\$1000)	39754

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			127	127	127	127	127	127
BASIN			4068	4068	4068	4068	4068	4068
PIPES			61	61	61	61	61	61
TOTAL C.O.M.	0	0	526	645	772	900	1029	1156
TOTAL ANNUAL	0	0	4734	4903	5070	5158	5286	5414

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A, LE-5

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	297	298	299	299	299	299	299	299
ANNUAL RUNOFF	5364	5425	5486	5486	5486	5486	5486	5486
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	3137	3173	3209	3209	3209	3209	3209	3209
TREATMENT PLANT	1233	1247	1261	1261	1261	1261	1261	1261

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	870		975					975		696
BASIN	69540		85200							8520
PIPES	10692		13100							1310
RESIDUAL	408									
NET CAPITAL	80694									TOTAL 10526

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	1264	1278	1483	1689	1689	1689	1689	1689
SLUDGE (\$1000/YR)	0	22	22	22	22	22	22	22	22
SEWERS (\$1000/YR)	0	65	65	65	65	65	65	65	65
TOTAL (\$1000/YR)	0	1351	1366	1571	1777	1777	1777	1777	1777
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	5571	6022	6866	12484	12484	12484		0
PRESENT WORTH (\$1000)	0	4547	3505	2848	3692	1877	953		0
NET O.+M. =		17426							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	80694
O.+M. (\$1000)	17426
LAND (\$1000)	80
TOTAL (\$1000)	98200

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING		75	75	75	75	75	75	75
BASIN		6168	6168	6168	6168	6168	6168	6168
PIPES		948	948	948	948	948	948	948
TOTAL O.+M.	0	1351	1366	1571	1777	1777	1777	1777
TOTAL ANNUAL	0	8543	8558	8764	8969	8969	8969	8969

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, LE-6

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	70	70	70	70	70	70	70	70
ANNUAL RUNOFF	1453	1453	1453	1453	1453	1453	1453	1453
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	850	850	850	850	850	850	850	850
TREATMENT PLANT	334	334	334	334	334	334	334	334

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	6515		7300					7300		5212
PLANT EXPANSION	4289					14500				2029
SLUDGE HANDLING	565		634					634		452
BASIN	9957		12200							1220
PIPES	6611		8100							810
RESIDUAL	377									
NET CAPITAL	27562									TOTAL 9724

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	90	90	324	559	559	559	559	559
SLUDGE (\$1000/YR)	0	5	5	5	5	5	5	5	5
SEWERS (\$1000/YR)	0	40	40	40	40	40	40	40	40
TOTAL (\$1000/YR)	0	136	136	371	605	605	605	605	605
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	559	1040	2002	4255	4255	4255		0
PRESENT WORTH (\$1000)	0	456	605	830	1258	639	325		0
NET O.+M. =	4117.2								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	27562
O.+M. (\$1000)	4117
LAND (\$1000)	25

TOTAL (\$1000) 31704

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		563	563	563	563	563	563	563
PLANT EXPANSION					1119	1119	1119	1119
SLUDGE HANDLING		48	48	48	48	48	48	48
BASIN		883	883	883	883	883	883	883
PIPES		586	586	586	586	586	586	586
TOTAL O.+M.	0	136	136	371	605	605	605	605
TOTAL ANNUAL	0	2218	2218	2453	3807	3807	3807	3807

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

**STORMWATER TREATMENT PLANT**
**CORPS OF ENGINEERS - SURVEY SCOPE STUDY**
**PLAN A - LE-7**

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	51	51	51	52	53	53	53	53
ANNUAL RUNOFF	969	969	969	1000	1031	1031	1031	1031
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	566	566	566	584	603	603	603	603
TREATMENT PLANT	222	222	222	230	237	237	237	237

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	423		474					474		338
BASIN	8162		10000							1000
PIPES	81		100							10
RESIDUAL	52									
NET CAPITAL	8614									1348

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	288	288	298	307	307	307	307	307
SLUDGE (\$1000/YR)	0	3	3	4	4	4	4	4	4
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	293	293	302	311	311	311	311	311
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	1202	1221	1259	2190	2190	2190	2190	0
PRESENT WORTH (\$1000)	0	981	710	522	448	329	167	0	0
NET O.+M. =	3359.72								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	8614
O.+M. (\$1000)	3359
LAND (\$1000)	20
TOTAL (\$1000)	11994

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING		36	36	36	36	36	36	36
BASIN		723	723	723	723	723	723	723
PIPES		7	7	7	7	7	7	7
TOTAL O.+M.	0	293	293	302	311	311	311	311
TOTAL ANNUAL	0	1061	1061	1070	1079	1079	1079	1079

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - LE-8

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	17	35	35	35	35	35	35
ANNUAL RUNOFF	0	328	656	656	656	656	656	656
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	615	1230	1230	1640	1640	1640	1640
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	3691			5800					5800	4970
PLANT EXPANSION	3549					12000				1679
SLUDGE HANDLING	231			363					363	311
BASIN	890			1530						305
PIPES	2956			5080						1015
RESIDUAL	321									
NET CAPITAL	10997								TOTAL	8283

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	40	115	190	190	190	190	190
SLUDGE (\$1000/YR)	0	0	25	25	32	32	32	32	32
SEWERS (\$1000/YR)	0	0	25	25	25	25	25	25	25
TOTAL (\$1000/YR)	0	0	91	166	248	248	248	248	248
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	528	849	1744	1744	1744	1744	0
PRESENT WORTH (\$1000)	0	0	307	352	516	262	133	0	0
NET O.+M. =	1572.26								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	10997
O.+M. (\$1000)	1572
LAND (\$1000)	20
TOTAL (\$1000)	12590

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			447	447	447	447	447	447
PLANT EXPANSION					926	926	926	926
SLUDGE HANDLING			28	28	28	28	28	28
BASIN			110	110	110	110	110	110
PIPES			367	367	367	367	367	367
TOTAL O.+M.	0	0	91	166	248	248	248	248
TOTAL ANNUAL	0	0	1046	1120	2129	2129	2129	2129

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - LE-9

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	18	37	38	39	39	39	39
ANNUAL RUNOFF	0	265	531	575	619	619	619	619
SLUDGE QUANTITIES (DT/YR):								
SEDIMENT BASIN	0	387	775	839	903	903	903	903
TREATMENT PLANT	0	0	323	350	372	377	377	377

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	70			110					110	94
BASIN	4888			8400						1679
PIPES	2793			4800						959
RESIDUAL	106								TOTAL	2734
NET CAPITAL	7646									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	157	175	193	193	193	193	193
SLUDGE (\$1000/YR)	0	0	25	26	28	28	28	28	28
SEWERS (\$1000/YR)	0	0	23	23	23	23	23	23	23
TOTAL (\$1000/YR)	0	0	206	226	245	245	245	245	245
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	887	967	1727	1727	1727	1727	0
PRESENT WORTH (\$1000)	0	0	516	401	310	259	131	0	0
NET O.+M. =	1821.04								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	7646
O.+M. (\$1000)	1821
LAND (\$1000)	15
TOTAL (\$1000)	9482

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			8	8	8	8	8	8
BASIN			608	608	608	608	608	608
PIPES			347	347	347	347	347	347
TOTAL O.+M.	0	0	206	226	245	245	245	245
TOTAL ANNUAL	0	0	1171	1190	1210	1210	1210	1210

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, LE-10

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	24	49	49	50	53	56	56
ANNUAL RUNOFF	0	338	676	686	696	747	799	799
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	633	1267	1286	1740	1867	1997	1997
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	4137			6500					6500	5570
PLANT EXPANSION	3993					13500				1889
SLUDGE HANDLING	301			474					474	406
BASIN	6984			12000						2399
PIPES	4103			7050						1409
RESIDUAL	453								TOTAL	11676
NET CAPITAL	19066									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	41	120	201	216	231	231
SLUDGE	(\$1000/YR)	0	0	29	28	38	41	43	43
SEWERS	(\$1000/YR)	0	0	35	35	35	35	35	35
TOTAL	(\$1000/YR)	0	0	106	184	275	292	310	310
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	597	943	1995	2120	2183	0
PRESENT WORTH (\$1000)									
		0	0	347	391	590	318	166	0
NET O.+M. =		1815.15							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	19066
O.+M. (\$1000)	1815
LAND (\$1000)	15
TOTAL (\$1000)	20896

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			501	501	501	501	501	501
PLANT EXPANSION					1042	1042	1042	1042
SLUDGE HANDLING			36	36	36	36	36	36
BASIN			868	868	868	868	868	868
PIPES			510	510	510	510	510	510
TOTAL O.+M.	0	0	186	184	275	292	310	310
TOTAL ANNUAL	0	0	2023	2102	3235	3252	3270	3270

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, LE-11 12

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	26	53	55	58	65	73	76
ANNUAL RUNOFF	0	368	737	779	822	933	1043	1089
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	321	1842	1948	2055	2332	2607	2722
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000).

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	7675				18500					0
SLUDGE HANDLING	290				700					0
BASIN	6721				16200					4860
RESIDUAL	188									
NET CAPITAL	14498									TOTAL 4860

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	238	238	270	302	315
SLUDGE	(\$1000/YR)	0	0	0	45	45	51	57	59
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	283	283	321	359	375
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	1162	2126	2394	2583	0
PRESENT WORTH (\$1000)		0	0	0	482	628	360	197	0
NET O.+M. =	1668.78								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	14498
O.+M. (\$1000)	1668
LAND (\$1000)	61
TOTAL (\$1000)	16228

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				1428	1428	1428	1428	1428
SLUDGE HANDLING				54	54	54	54	54
BASIN				1172	1172	1172	1172	1172
TOTAL O.+M.	0	0	0	283	283	321	359	375
TOTAL ANNUAL	0	0	0	2938	2938	2977	3014	3030

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-1

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	32	32	32	32	33	33	33	33
ANNUAL RUNOFF	631	631	631	637	644	644	644	644
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	448	448	448	452	978	978	978	978
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	5087		5700					5700		4069
PLANT EXPANSION	4771				11500					0
SLUDGE HANDLING	191		214					214		152
BASIN	5590		6850							685
PIPES	163		200							20
RESIDUAL	191								TOTAL	4927
NET CAPITAL	15613									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	39	39	142	247	247	247	247	247
SLUDGE (\$1000/YR)	0	2	2	2	4	4	4	4	4
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	42	42	145	253	253	253	253	253
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	173	385	819	1782	1782	1782	1782	0
PRESENT WORTH (\$1000)	0	141	224	339	527	268	136	0	0
NET O.+M. =	1637.76								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	15613
O.+M. (\$1000)	1637
LAND (\$1000)	20
TOTAL (\$1000)	17270

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		440	440	440	440	440	440	440
PLANT EXPANSION				887	887	887	887	887
SLUDGE HANDLING		16	16	16	16	16	16	16
BASIN		495	495	495	495	495	495	495
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	42	42	145	253	253	253	253
TOTAL ANNUAL	0	1009	1009	2000	2108	2108	2108	2108

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A. CU-2

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	61	61	61	61	62	62	62	62
ANNUAL RUNOFF	1147	1147	1147	1183	1220	1220	1220	1220
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	814	814	814	840	1854	1854	1854	1854
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	6248		7000					7000		4997
PLANT EXPANSION	5808				14000					0
SLUDGE HANDLING	361		405					405		289
BASIN	8366		10250							1025
PIPES	163		200							20
RESIDUAL	245								TOTAL	4332
NET CAPITAL	20701									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	71	71	264	469	469	469	469	469
SLUDGE (\$1000/YR)	0	4	4	4	9	9	9	9	9
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	76	76	269	479	479	479	479	479
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	312	709	1536	3371	3371	3371	3371	0
PRESENT WORTH (\$1000)	0	254	412	637	997	507	257	0	0
NET O.+M. =	3067.04								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	20701
O.+M. (\$1000)	3067
LAND (\$1000)	25
TOTAL (\$1000)	23793

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		540	540	540	540	540	540	540
PLANT EXPANSION				1080	1080	1080	1080	1080
SLUDGE HANDLING		31	31	31	31	31	31	31
BASIN		742	742	742	742	742	742	742
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	76	76	269	479	479	479	479
TOTAL ANNUAL	0	1404	1404	2678	2809	2889	2889	2889

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

**STORMWATER TREATMENT PLANT**
**COMPS OF ENGINEERS - SURVEY SCOPE STUDY**
**PLAN A . CU-3**

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	43	43	43	44	45	45	45	45
ANNUAL RUNOFF	742	742	742	788	835	835	835	835
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	526	526	526	559	1269	1269	1269	1269
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

**TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)**

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	5623		6300					6300		4498
PLANT EXPANSION	5269				12700					0
SLUDGE HANDLING	248		278					278		198
BASIN	6774		8300							830
PIPES	163		200							20
RESIDUAL	215								TOTAL	5546
NET CAPITAL	17863									

**TABLE II : PRESENT WORTH - O.+M. COSTS**

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	46	46	174	321	321	321	321	321
SLUDGE (\$1000/YR)	0	2	2	2	6	6	6	6	6
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	49	49	180	328	328	328	328	328
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	203	470	1043	2309	2309	2309	2309	0
PRESENT WORTH (\$1000)	0	166	274	432	663	347	176	0	0
NET O.+M. =	2079.87								

**TABLE III : TOTAL PRESENT WORTH**

CAPITAL (\$1000)	17863
O.+M. (\$1000)	2079
LAND (\$1000)	20
TOTAL (\$1000)	19963

**TABLE IV : ANNUAL COSTS (\$1000/YR)**

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		486	486	486	486	486	486	486
PLANT EXPANSION				980	980	980	980	980
SLUDGE HANDLING		21	21	21	21	21	21	21
BASIN		600	600	600	600	600	600	600
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	49	49	180	328	328	328	328
TOTAL ANNUAL	0	117	1172	2283	2432	2432	2432	2432

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-4A

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	30	31	32	32	33	34	35	35
ANNUAL RUNOFF	424	462	500	513	527	575	642	642
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	301	328	354	364	801	874	975	975
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	6962		7800					7800		5569
PLANT EXPANSION	3236				7800					0
SLUDGE HANDLING	191		214					214		152
BASEIN	5427		6650							465
PIPES	11018		13500							1350
RESIDUAL	300									
NET CAPITAL	26535								TOTAL	7736

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	28	31	114	202	221	247	247
SLUDGE	(\$1000/YR)	0	1	1	1	4	4	4	4
SEWERS	(\$1000/YR)	0	67	67	67	67	67	67	67
TOTAL	(\$1000/YR)	0	97	100	184	274	293	319	319
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	406	582	939	1993	2151	2244	0
PRESENT WORTH (\$1000)		0	331	339	369	589	323	171	0
NET O.+M. =									2145.44

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	26535
O.+M. (\$1000)	2145
LAND (\$1000)	50
TOTAL (\$1000)	28731

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		602	602	602	602	602	602	602
PLANT EXPANSION				602	602	602	602	602
SLUDGE HANDLING		16	16	16	16	16	16	16
BASEIN		481	481	481	481	481	481	481
PIPES		977	977	977	977	977	977	977
TOTAL O.+M.	0	97	100	184	274	293	319	319
TOTAL ANNUAL	0	2175	2177	2865	2954	2972	2999	2999

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A, CU-48-C-0

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	230	237	245	247	249	256	269	269
ANNUAL RUNOFF	3240	3540	3840	3945	4050	4400	4940	4940
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	4730	5160	5606	5750	5913	6424	7212	7212
TREATMENT PLANT	1976	2159	2342	2406	2470	2684	3013	3013

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	1934			3040					3040	2605
BASIN	395			680						135
PIPES	931			1600						319
RESIDUAL	118									
NET CAPITAL	3143								TOTAL	3061

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	760	929	1105	1201	1348	1348
SLUDGE	(\$1000/YR)	0	0	151	156	160	174	195	195
SEWERS	(\$1000/YR)	0	0	7	7	7	7	7	7
TOTAL	(\$1000/YR)	0	0	920	1093	1273	1383	1551	1551
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	4127	4852	9330	10307	10900	0
PRESENT WORTH (\$1000)		0	0	2402	2013	2760	1550	832	0
NET O.+M. =		9558.43							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3143
O.+M. (\$1000)	9558
LAND (\$1000)	1800
TOTAL (\$1000)	14501

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			234	234	234	234	234	234
BASIN			49	49	49	49	49	49
PIPES			115	115	115	115	115	115
TOTAL O.+M.	0	0	920	1093	1273	1383	1551	1551
TOTAL ANNUAL	0	0	1317	1492	1673	1782	1951	1951

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A, CU-5

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	141	144	147	148	150	154	162	162
ANNUAL RUNOFF	2044	2175	2307	2373	2439	2637	2967	2967
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	1451	1544	1637	1684	3707	4008	4509	4509
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	8747		9800					9800		6997
PLANT EXPANSION	7468				18000					0
SLUDGE HANDLING	892		1000					1000		713
BASIN	17303		21200							2120
PIPES	163		200							20
RESIDUAL	382								TOTAL	9851
NET CAPITAL	34192									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	134	143	530	939	1015	1142	1142
SLUDGE	(\$1000/YR)	0	7	8	8	18	20	22	22
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	143	152	539	958	1036	1165	1165
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	606	1418	3071	7005	7733	8188	0
PRESENT WORTH (\$1000)		0	494	825	1274	2072	1163	625	0
NET O.+M. =	6455.95								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	34192
O.+M. (\$1000)	6455
LAND (\$1000)	346
TOTAL (\$1000)	40994

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		756	756	756	756	756	756	756
PLANT EXPANSION				1389	1389	1389	1389	1389
SLUDGE HANDLING		77	77	77	77	77	77	77
BASIN		1534	1534	1534	1534	1534	1534	1534
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	143	152	539	958	1036	1165	1165
TOTAL ANNUAL	0	2526	2535	4312	4731	4509	4938	4938

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

COMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-6 12

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	38	39	41	42	44	47	49	49
ANNUAL RUNOFF	526	547	568	600	633	677	790	790
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	767	798	829	876	924	988	1153	1153
TREATMENT PLANT	320	333	346	366	386	412	481	481

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	283			446					446	382
BASIN	5470			9400						1879
PIPES	954			1640						327
RESIDUAL	100								TOTAL	2590
NET CAPITAL	6608									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	132	162	194	208	243	243	
SLUDGE (\$1000/YR)	0	0	5	6	6	7	8	8	
SEWERS (\$1000/YR)	0	0	8	8	8	8	8	8	
TOTAL (\$1000/YR)	0	0	146	176	209	223	259	259	
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	662	792	1522	1697	1823	0	
PRESENT WORTH (\$1000)	0	0	385	328	450	255	139	0	
NET O.+M. =	1559.43								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	6608
O.+M. (\$1000)	1559
LAND (\$1000)	105
TOTAL (\$1000)	8273

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			34	34	34	34	34	34
BASIN			680	680	680	680	680	680
PIPES			118	118	118	118	118	118
TOTAL O.+M.	0	0	146	176	209	223	259	259
TOTAL ANNUAL	0	0	980	1010	1043	1057	1093	1093

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-7 18

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	7	15	19	23	30	37	46
ANNUAL RUNOFF	0	111	223	278	334	446	577	600
SLUDGE QUANTITIES (D1/YR)								
SLUIMENT-BASIN	0	162	325	406	487	651	842	876
TREATMENT PLANT	0	0	136	169	203	272	351	366

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	33				80					0
BASIN	236				570					171
PIPES	1452				3500					1050
RESIDUAL	47									
NET CAPITAL	1674									TOTAL 1221

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	91	91	121	157	163
SLUDGE	(\$1000/YR)	0	0	0	13	13	17	22	23
SEWERKS	(\$1000/YR)	0	0	0	17	17	17	17	17
TOTAL	(\$1000/YR)	0	0	0	121	121	156	197	205
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	499	979	1245	1414	0
PRESENT WORTH (\$1000)									
		0	0	0	207	289	187	108	0
NET O.+M. =		792,403							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1674
O.+M. (\$1000)	792
LAND (\$1000)	288
TOTAL (\$1000)	2754

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				6	6	6	6	6
BASIN				41	41	41	41	41
PIPES				253	253	253	253	253
TOTAL O.+M.	0	0	0	121	121	156	197	205
TOTAL ANNUAL	0	0	0	422	422	457	498	505

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-8

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	42	84	86	89	93	98	98
ANNUAL RUNOFF	0	577	1155	1199	1243	1296	1386	1386
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	843	1686	1750	1814	1892	2023	2023
TREATMENT PLANT	0	352	704	731	756	790	845	845

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	117			185					185	158
BASIN	477			820						163
PIPES	174			300						59
RESIDUAL	14								TOTAL	382
NET CAPITAL	754									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	228	282	339	353	378	378
SLUDGE	(\$1000/YR)	0	0	45	47	49	51	54	54
SEWERS	(\$1000/YR)	0	0	1	1	1	1	1	1
TOTAL	(\$1000/YR)	0	0	275	331	389	406	434	434
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	1244	1478	2797	2954	3053	0
PRESENT WORTH (\$1000)		0	0	724	613	827	444	233	0
NET O.+M. =	2842.94								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	754
O.+M. (\$1000)	2842
LAND (\$1000)	591
TOTAL (\$1000)	4188

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			14	14	14	14	14	14
BASIN			59	59	59	59	59	59
PIPES			21	21	21	21	21	21
TOTAL O.+M.	0	0	275	331	389	406	434	434
TOTAL ANNUAL	0	0	371	426	485	501	530	530

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## LOUPE OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CU-9

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	4	6	7
ANNUAL RUNOFF	0	0	0	0	0	74	89	112
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	108	129	163
TREATMENT PLANT	0	0	0	0	0	45	54	68

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	2						15			6
BASIN	33						220			132
PIPES	300						2000			1200
RESIDUAL	51									
NET CAPITAL	284									TOTAL 1338

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	20	24	30
SLUDGE (\$1000/YR)	0	0	0	0	0	0	2	3	4
SEWERS (\$1000/YR)	0	0	0	0	0	0	9	9	9
TOTAL (\$1000/YR)	0	0	0	0	0	0	33	37	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	249	290	
PRESENT WORTH (\$1000)	0	0	0	0	0	0	37	22	0
NET O.+M. =	59.6922								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	284
O.+M. (\$1000)	59
LAND (\$1000)	24
TOTAL (\$1000)	367

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING						1	1	1
BASIN						15	15	15
PIPES						144	144	144
TOTAL O.+M.	0	0	0	0	0	33	37	45
TOTAL ANNUAL	0	0	0	0	0	195	199	206

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## COMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CU-10

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	5	6	8	11
ANNUAL RUNOFF	0	0	0	40	80	97	121	162
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	116	141	176	236
TREATMENT PLANT	0	0	0	0	48	59	73	98

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	63					216				30
BASIN	79					270				107
PIPES	88					300				119
RESIDUAL	10									
NET CAPITAL	222									258

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	21	26	33	44
SLUDGE	(\$1000/YR)	0	0	0	0	3	3	4	6
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	26	31	39	52
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	204	249	321	0
PRESENT WORTH (\$1000)									
		0	0	0	0	60	37	24	0
NET O.+M. = 122.491									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	222
O.+M. (\$1000)	122
LAND (\$1000)	34
TOTAL (\$1000)	379

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					16	16	16	16
BASIN					19	19	19	19
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	26	31	39	52
TOTAL ANNUAL	0	0	0	0	84	89	97	110

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CU-11

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	12	24	24	24	26	27	27
ANNUAL RUNOFF	0	168	337	341	346	370	432	432
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	246	492	498	505	540	630	630
TREATMENT PLANT	0	0	205	208	211	225	263	263

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	36			58					58	49
BASIN	261			450						89
PIPES	174			300						59
RESIDUAL	7								TOTAL	199
NET CAPITAL	465									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	66	80	94	101	117	117
SLUDGE	(\$1000/YR)	0	0	13	13	13	14	17	17
SEWERS	(\$1000/YR)	0	0	1	1	1	1	1	1
TOTAL	(\$1000/YR)	0	0	81	95	109	117	136	136
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	362	420	796	890	958	0
PRESENT WORTH (\$1000)		0	0	211	174	235	133	73	0
NET O.+M. -	828.405								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	465
O.+M. (\$1000)	828
LAND (\$1000)	184
TOTAL (\$1000)	1478

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			4	4	4	4	4	4
BASIN			32	32	32	32	32	32
PIPES			21	21	21	21	21	21
TOTAL O.+M.	0	0	81	95	109	117	136	136
TOTAL ANNUAL	0	0	140	154	168	175	195	195

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CURPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-13

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	6	13	16	20	27	34	40
ANNUAL RUNOFF	0	99	198	247	297	396	494	594
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	247	495	618	742	990	1235	1485
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1991				4800					0
BASIN	128				310					93
PIPES	82				200					60
RESIDUAL	5									
NET CAPITAL	2197									TOTAL 153

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	74	74	99	123	148
SLUDGE	(\$1000/YR)	0	0	0	18	18	24	30	37
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	93	93	124	155	186
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	384	767	983	1201	0
PRESENT WORTH (\$1000)		0	0	0	159	227	147	91	0
NET O.+M. =	626.335								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2197
O.+M. (\$1000)	626
LAND (\$1000)	45
TOTAL (\$1000)	2868

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				370	370	370	370	370
BASIN				22	22	22	22	22
PIPES				14	14	14	14	14
TOTAL G.+M.	0	0	0	93	93	124	155	186
TOTAL ANNUAL	0	0	0	501	501	522	562	594

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-14

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	15	31	31	32	33	35	35
ANNUAL RUNOFF	0	212	425	435	446	466	500	500
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	310	620	635	651	680	730	730
TREATMENT PLANT	0	0	259	265	272	284	305	305

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	1				3					0
BASIN	203				490					147
PIPES	601				1450					435
RESIDUAL	22									
NET CAPITAL	783								TOTAL	582

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	121	121	127	136	136
SLUDGE	(\$1000/YR)	0	0	0	17	17	18	19	19
SEWERS	(\$1000/YR)	0	0	0	7	7	7	7	7
TOTAL	(\$1000/YR)	0	0	0	146	146	152	163	163
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		0	0	0	601	1051	1111	1148	0
PRESENT WORTH (\$1000)		0	0	0	249	311	167	87	0
NET O.+M. =									815.497

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	783
O.+M. (\$1000)	815
LAND (\$1000)	107
TOTAL (\$1000)	1706

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				0	0	0	0	0
BASIN				35	35	35	35	35
PIPES				104	134	104	104	104
TOTAL O.+M.	0	0	0	146	146	152	163	163
TOTAL ANNUAL	0	0	0	237	237	293	304	304

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-15

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	1	3	3	3
ANNUAL RUNOFF	0	0	0	14	28	42	56	56
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	40	61	81	81
TREATMENT PLANT	0	0	0	0	17	25	34	34

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	2					8				1
BASIN	47					160				63
PIPES	88					300				119
RESIDUAL	7									
NET CAPITAL	131									TOTAL 185

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	7	11	15	15
SLUDGE	(\$1000/YR)	0	0	0	0	1	1	2	2
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	10	14	19	19
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	87	118	133	0
PRESENT WORTH (\$1000)									
		0	0	0	0	25	17	10	0
NET O.+M. =		53.8021							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	131
O.+M. (\$1000)	53
LAND (\$1000)	12
TOTAL (\$1000)	197

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					0	0	0	0
BASIN					11	11	11	11
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	10	14	19	19
TOTAL ANNUAL	0	0	0	0	44	48	52	52

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-16

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	5	6	7	10	13	13
ANNUAL RUNOFF	0	39	78	98	118	157	196	196
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	56	113	143	172	229	286	286
TREATMENT PLANT	0	0	47	59	71	95	119	119

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) :

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	10				26					0
BASIN	124				300					90
PIPES	124				300					90
RESIDUAL	6									
NET CAPITAL	252									TOTAL 180

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	32	32	42	53	53
SLUDGE	(\$1000/YR)	0	0	0	4	4	6	7	7
SEWERS	(\$1000/YR)	0	0	0	1	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	38	38	50	62	62
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		0	0	0	157	312	397	440	0
PRESENT WORTH (\$1000)		0	0	0	65	92	59	33	0
NET O.+M. =		251.225							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	252
O.+M. (\$1000)	251
LAND (\$1000)	42
TOTAL (\$1000)	545

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				2	2	2	2	2
BASIN				21	21	21	21	21
PIPES				21	21	21	21	21
TOTAL O.+M.	0	0	0	38	38	50	62	62
TOTAL ANNUAL	0	0	0	83	83	96	108	108

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-17

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	1	3	4	5	7	9	10
ANNUAL RUNOFF	0	30	60	74	89	102	138	149
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	43	87	108	129	148	201	217
TREATMENT PLANT	0	0	36	45	54	62	84	90

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	8				20					0
BASIN	107				260					78
PIPES	1269				3060					918
RESIDUAL	38									
NET CAPITAL	1347									TOTAL 996

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	24	24	27	37	40
SLUDGE	(\$1000/YR)	0	0	0	3	3	4	5	5
SEWERS	(\$1000/YR)	0	0	0	15	15	15	15	15
TOTAL	(\$1000/YR)	0	0	0	43	43	47	58	61
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000):									
		0	0	0	176	317	370	422	0
PRESENT WORTH	(\$1000)	0	0	0	73	93	55	32	0
NET O.+M. =	255.203								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1347
O.+M. (\$1000)	255
LAND (\$1000)	31

TOTAL (\$1000) 1633

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				1	1	1	1	1
BASIN				18	18	18	18	18
PIPES				221	221	221	221	221
TOTAL O.+M.	0	0	0	43	43	47	58	61
TOTAL ANNUAL	0	0	0	265	283	289	300	303

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A . CU-19 20 32

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	6	13	13	14	49	61	71
ANNUAL RUNOFF	0	94	188	192	197	717	902	1028
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	235	470	481	492	1792	2255	2570
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1286				3100					0
PLANT EXPANSION	1331					4500				629
BASIN	36				88					26
BASIN	89					302				120
PIPES	207				500					150
PIPES	532					1800				719
RESIDUAL	63									
NET CAPITAL	3419								TOTAL	1647

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	49	49	179	225	257
SLUDGE	(\$1000/YR)	0	0	0	12	12	44	56	64
SEWERS	(\$1000/YR)	0	0	0	2	11	11	11	11
TOTAL	(\$1000/YR)	0	0	0	64	73	235	293	332
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	281	1083	1857	2198	0
PRESENT WORTH (\$1000)									
		0	0	0	116	320	279	167	0
NET O.+M. = 884.58									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3419
O.+M. (\$1000)	884
LAND (\$1000)	71
TOTAL (\$1000)	4374

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				239	239	239	239	239
PLANT EXPANSION					347	347	347	347
BASIN				6	6	6	6	6
BASIN					21	21	21	21
PIPES				36	36	36	36	36
PIPES					130	130	130	130
TOTAL O.+M.	0	0	0	64	73	235	293	332
TOTAL ANNUAL	0	0	0	345	854	1017	1076	1114

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CU-21

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	3	6	7	9	10
ANNUAL RUNOFF	0	0	0	45	91	108	135	163
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	132	157	197	237
TREATMENT PLANT	0	0	0	0	55	65	82	99

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	6					22				3
BASIN	79					270				107
PIPES	118					400				159
RESIDUAL	10									
NET CAPITAL	194									
									TOTAL	271

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	24	29	36	44
SLUDGE	(\$1000/YR)	0	0	0	0	4	5	6	8
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	31	37	45	54
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	240	291	353	0
PRESENT WORTH	(\$1000)	0	0	0	0	71	43	27	0
NET O.+M. =		142.116							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	194
O.+M. (\$1000)	142
LAND (\$1000)	33
TOTAL (\$1000)	369

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					1	1	1	1
BASIN					19	19	19	19
PIPES					28	28	28	28
TOTAL O.+M.	0	0	0	0	31	37	45	54
TOTAL ANNUAL	0	0	0	0	81	87	96	105

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CU-22

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	4	4	5	7
ANNUAL RUNOFF	0	0	0	30	61	72	91	109
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	89	105	132	159
TREATMENT PLANT	0	0	0	0	37	43	55	66

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	4					15				2
BASIN	65					220				87
PIPES	118					400				159
RESIDUAL	9									
NET CAPITAL	178									
									TOTAL	250

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	16	19	24	29
SLUDGE	(\$1000/YR)	0	0	0	0	2	2	3	4
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	21	24	30	36
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	160	192	233	0
PRESENT WORTH (\$1000)									
		0	0	0	0	47	29	17	0
NET O.+M. = 94,201.									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	178
O.+M. (\$1000)	94
LAND (\$1000)	22
TOTAL (\$1000)	294

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING					1	1	1	1
BASIN					15	15	15	15
PIPES					28	28	28	28
TOTAL O.+M.	0	0	0	0	21	24	30	36
TOTAL ANNUAL	0	0	0	0	67	70	76	82

OTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

OTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CU-23

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	1	2	2	2	5	7	7
ANNUAL RUNOFF	0	27	55	55	55	81	108	119
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	40	80	80	80	118	157	173
TREATMENT PLANT	0	0	33	33	33	49	65	72

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	6				16					0
BASIN	95				230					69
PIPES	962				2320					694
RESIDUAL	29									
NET CAPITAL	1034									
										TOTAL 765

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	15	15	22	29	32
SLUDGE	(\$1000/YR)	0	0	0	2	2	3	4	4
SEWERS	(\$1000/YR)	0	0	0	11	11	11	11	11
TOTAL	(\$1000/YR)	0	0	0	28	28	36	45	48
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	118	230	288	330	0
PRESENT WORTH (\$1000)									
		0	0	0	48	68	43	25	0
NET O.+M. = 185.944									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1034
O.+M. (\$1000)	185
LAND (\$1000)	25
TOTAL (\$1000)	1245

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				1	1	1	1	1
BASIN				16	16	16	16	16
PIPES				167	167	167	167	167
TOTAL O.+M.	0	0	0	28	28	36	45	48
TOTAL ANNUAL	0	0	0	214	214	222	231	234

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-24

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	5	10	12	15	20	25	25
ANNUAL RUNOFF	0	74	149	186	223	297	372	372
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	148	217	271	325	433	543	543
TREATMENT PLANT	0	0	90	113	136	181	226	226

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	20				50					0
BASIN	174				420					126
PIPES	124				300					90
RESIDUAL	0									
NET CAPITAL	311									TOTAL 216

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	60	60	81	101	101	
SLUDGE (\$1000/YR)	0	0	0	8	8	11	14	14	
SEWERS (\$1000/YR)	0	0	0	1	1	1	1	1	
TOTAL (\$1000/YR)	0	0	0	71	71	94	117	117	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	291	581	744	827	0	
PRESENT WORTH (\$1000)	0	0	0	121	171	112	63	0	
NET O.+M. =	468.278								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	311
O.+M. (\$1000)	468
LAND (\$1000)	79
TOTAL (\$1000)	858

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				3	3	3	3	3
BASIN				30	30	30	30	30
PIPES				21	21	21	21	21
TOTAL O.+M.	0	0	0	71	71	94	117	117
TOTAL ANNUAL	0	0	0	127	127	150	173	173

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-25 & 35

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	19	39	40	41	67	82	90
ANNUAL RUNOFF	0	260	520	542	564	982	1228	1327
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	650	1300	1355	1410	2455	3070	3317
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1825				4400					0
PLANT EXPANSION	1286					4350				608
BASIN	116				280					84
BASIN	89					304				121
PIPES	248				600					180
PIPES	59					200				79
RESIDUAL	41									
NET CAPITAL	3584								TOTAL	1074

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	141	141	245		307	331
SLUDGE (\$1000/YR)	0	0	0	35	35	61		76	82
SEWERS (\$1000/YR)	0	0	0	2	3	3		3	3
TOTAL (\$1000/YR)	0	0	0	179	180	310		387	418
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	736	1724	2453		2832	0
PRESENT WORTH (\$1000)	0	0	0	305	510	368		216	0
NET O.+M. =	1401.3								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3584
O.+M. (\$1000)	1401
LAND (\$1000)	102
TOTAL (\$1000)	5088

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				339	339	339	339	339
PLANT EXPANSION					335	335	335	335
BASIN				20	20	20	20	20
BASIN					22	22	22	22
PIPES				43	43	43	43	43
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	179	180	310	387	418
TOTAL ANNUAL	0	0	0	562	955	1086	1163	1194

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CU-26

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	1	3	4	5	6	8	8
ANNUAL RUNOFF	0	27	54	67	81	91	123	134
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	67	135	168	202	227	307	335
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	995				2400					0
BASIN	58				140					42
PIPES	82				200					60
RESIDUAL	3									
NET CAPITAL	1132									TOTAL 102

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	20	20	22	30	33
SLUDGE	(\$1000/YR)	0	0	0	5	5	5	7	8
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	26	26	29	39	42
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	107	195	241	289	0
PRESENT WORTH (\$1000)		0	0	0	44	57	36	22	0
NET O.+M. =	161.134								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1132
O.+M. (\$1000)	161
LAND (\$1000)	10
TOTAL (\$1000)	1304

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				185	185	185	185	185
BASIN				10	10	10	10	10
PIPES				14	14	14	14	14
TOTAL O.+M.	0	0	0	26	26	29	39	42
TOTAL ANNUAL	0	0	0	236	236	239	249	252

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-27

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	4	9	10	12	17	22	22
ANNUAL RUNOFF	0	63	126	158	190	252	316	316
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	157	315	395	475	630	790	790
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1535				3700					0
BASIN	95				230					69
PIPES	1680				4050					1215
RESIDUAL	49									
NET CAPITAL	3261									TOTAL 1284

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	47	47	63	79	79
SLUDGE	(\$1000/YR)	0	0	0	11	11	15	19	19
SEWERS	(\$1000/YR)	0	0	0	20	20	20	20	20
TOTAL	(\$1000/YR)	0	0	0	79	79	98	118	118
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)									
		0	0	0	326	627	765	835	0
PRESENT WORTH (\$1000)									
		0	0	0	135	185	115	63	0
NET O.+M. = 499.999									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3261
O.+M. (\$1000)	499
LAND (\$1000)	24
TOTAL (\$1000)	3785

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				285	285	285	285	285
BASIN				16	16	16	16	16
PIPES				293	293	293	293	293
TOTAL O.+M.	0	0	0	79	79	98	118	118
TOTAL ANNUAL	0	0	0	675	675	694	714	714

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-28

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	4	5	7	8
ANNUAL RUNOFF	0	0	0	36	72	86	108	121
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	180	215	270	302
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	709					2400				335
BASIN	44					150				59
PIPES	532					1800				719
RESIDUAL	43									
NET CAPITAL	1243									TOTAL 1115

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	18	21	27	30
SLUDGE	(\$1000/YR)	0	0	0	0	4	5	6	7
SEWERS	(\$1000/YR)	0	0	0	0	8	8	8	8
TOTAL	(\$1000/YR)	0	0	0	0	31	35	42	46
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	236	276	314	0
PRESENT WORTH (\$1000)									
		0	0	0	0	69	41	24	0
NET O.+M. =		135.544							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1243
O.+M. (\$1000)	135
LAND (\$1000)	2
TOTAL (\$1000)	1380

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					185	185	185	185
BASIN					10	10	10	10
PIPES					130	130	130	130
TOTAL O.+M.	0	0	0	0	31	35	42	46
TOTAL ANNUAL	0	0	0	0	357	362	369	373

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-29631

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	21	27	34
ANNUAL RUNOFF	0	0	0	0	0	329	395	495
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	822	987	1237
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	676						4500			1930
BASIN	43						290			174
PIPES	330						2200			1320
RESIDUAL	132									
NET CAPITAL	918									TOTAL 3424

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	82	98	123
SLUDGE (\$1000/YR)	0	0	0	0	0	0	20	24	30
SEWERS (\$1000/YR)	0	0	0	0	0	0	10	10	10
TOTAL (\$1000/YR)	0	0	0	0	0	0	113	134	165
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	871	1053	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	131	80	0
NET O.+M. =	211.64								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	918
O.+M. (\$1000)	211
LAND (\$1000)	8
TOTAL (\$1000)	1138

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						347	347	347
BASIN						20	20	20
PIPES						159	159	159
TOTAL O.+M.	0	0	0	0	0	113	134	165
TOTAL ANNUAL	0	0	0	0	0	641	662	693

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CU-30

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	6	8
ANNUAL RUNOFF	0	0	0	0	0	86	103	129
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	215	257	322
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	375						2500			1072
BASIN	22						150			90
PIPES	582						3870			2322
RESIDUAL	135									
NET CAPITAL	845									TOTAL 3484

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	21	25	32
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	6	8
SEWERS (\$1000/YR)	0	0	0	0	0	0	19	19	19
TOTAL (\$1000/YR)	0	0	0	0	0	0	46	51	59
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	343	390	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	51	29	0
NET O.+M. =	81.46%								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	845
O.+M. (\$1000)	81
LAND (\$1000)	2
TOTAL (\$1000)	928

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						192	192	192
BASIN						10	10	10
PIPES						280	280	280
TOTAL O.+M.	0	0	0	0	0	46	51	59
TOTAL ANNUAL	0	0	0	0	0	530	535	543

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CU-33

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	1	2	3	5	7	8	8
ANNUAL RUNOFF	0	27	54	67	81	108	134	134
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	39	78	98	118	157	195	195
TREATMENT PLANT	0	0	32	41	49	65	81	81

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000):

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	7				18					0
BASIN	103				250					75
PIPES	1124				2710					813
RESIDUAL	34									
NET CAPITAL	1201									888

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	22	22	29	36	36
SLUDGE	(\$1000/YR)	0	0	0	3	3	4	5	5
SEWERS	(\$1000/YR)	0	0	0	13	13	13	13	13
TOTAL	(\$1000/YR)	0	0	0	38	38	47	55	55
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	159	302	360	389	0
PRESENT WORTH (\$1000)		0	0	0	66	89	54	29	0
NET O.+M. =	239.637								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1201
O.+M. (\$1000)	239
LAND (\$1000)	6
TOTAL (\$1000)	1446

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				1	1	1	1	1
BASIN				18	18	18	18	18
PIPES				196	196	196	196	196
TOTAL O.+M.	0	0	0	38	38	47	55	55
TOTAL ANNUAL	0	0	0	254	254	262	271	271

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-34A

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	2	3	4
ANNUAL RUNOFF	0	0	0	0	0	33	50	60
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	82	125	150
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	233						1550			644
BASIN	13						90			54
PIPES	267						1780			1068
RESIDUAL	69								TOTAL	1786
NET CAPITAL	445									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	8	12	15
SLUDGE (\$1000/YR)	0	0	0	0	0	0	2	3	3
SEWERS (\$1000/YR)	0	0	0	0	0	0	8	8	8
TOTAL (\$1000/YR)	0	0	0	0	0	0	19	24	27
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	153	163	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	23	13	0
NET O.+M. =	37.0991								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	445
O.+M. (\$1000)	37
LAND (\$1000)	1
TOTAL (\$1000)	483

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						119	119	119
BASIN						6	6	6
PIPES						128	128	128
TOTAL O.+M.	0	0	0	0	0	19	24	27
TOTAL ANNUAL	0	0	0	0	0	274	279	282

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-348

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	2	3
ANNUAL RUNOFF	0	0	0	0	0	22	33	40
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	55	82	100
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	210						1400			600
BASIN	12						81			48
PIPES	30						200			120
RESIDUAL	29									
NET CAPITAL	222								TOTAL	769

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	5	8	10
SLUDGE (\$1000/YR)	0	0	0	0	0	0	1	2	2
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	7	11	13
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	67	87	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	10	6	0
NET O.+M. =	16.7913								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	222
O.+M. (\$1000)	16
LAND (\$1000)	1
TOTAL (\$1000)	240

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						108	108	108
BASIN						5	5	5
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	7	11	13
TOTAL ANNUAL	0	0	0	0	0	136	139	141

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A , CU-34C E 40641

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	7	11
ANNUAL RUNOFF	0	0	0	0	0	93	111	138
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	232	277	345
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) .

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	421						2800			1201
BASIN	26						175			105
PIPES	451						3000			1800
RESIDUAL	120									
NET CAPITAL	778									
									TOTAL	3106

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	23	27	34
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	6	8
SEWERS (\$1000/YR)	0	0	0	0	0	0	14	14	14
TOTAL (\$1000/YR)	0	0	0	0	0	0	44	49	58
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	329	378	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	49	28	0
NET O.+M. =	78.4414								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	778
O.+M. (\$1000)	78
LAND (\$1000)	2
TOTAL (\$1000)	858

TABLE IV : ANNUAL COSTS (\$1000/YR) :

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						216	216	216
BASIN						12	12	12
PIPES						217	217	217
TOTAL O.+M.	0	0	0	0	0	44	49	58
TOTAL ANNUAL	0	0	0	0	0	490	495	504

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CU-340

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	3	5	6
ANNUAL RUNOFF	0	0	0	0	0	50	74	90
SLUDGE QUANTITIES (QT/YR)								
SEDIMENT BASIN	0	0	0	0	0	125	185	225
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	293						1950			836
BASIN	17						115			69
PIPES	530						3530			2118
RESIDUAL	117									
NET CAPITAL	724								TOTAL	3023

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	12	18	22
SLUDGE (\$1000/YR)	0	0	0	0	0	0	3	4	5
SEWERS (\$1000/YR)	0	0	0	0	0	0	17	17	17
TOTAL (\$1000/YR)	0	0	0	0	0	0	33	40	45
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	260	303	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	39	23	0
NET O.+M. =	62.3319								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	724
O.+M. (\$1000)	62
LAND (\$1000)	2
TOTAL (\$1000)	788

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						150	150	150
BASIN						8	8	8
PIPES						255	255	255
TOTAL O.+M.	0	0	0	0	0	33	40	45
TOTAL ANNUAL	0	0	0	0	0	447	455	440

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-36

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	10	13
ANNUAL RUNOFF	0	0	0	0	0	139	167	209
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	347	417	522
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	466						3100			1329
BASIN	28						190			114
PIPES	1114						7410			4446
RESIDUAL	228									
NET CAPITAL	1380									5889

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	0	34	41	52
SLUDGE	(\$1000/YR)	0	0	0	0	0	8	10	13
SEWERS	(\$1000/YR)	0	0	0	0	0	37	37	37
TOTAL	(\$1000/YR)	0	0	0	0	0	80	89	102
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		0	0	0	0	0	596	672	0
PRESENT WORTH (\$1000)		0	0	0	0	0	89	51	0
NET O.+M. =									141.049

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1380
O.+M. (\$1000)	141
LAND (\$1000)	3
TOTAL (\$1000)	1524

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						239	239	239
BASIN						13	13	13
PIPES						536	536	536
TOTAL O.+M.	0	0	0	0	0	80	89	102
TOTAL ANNUAL	0	0	0	0	0	670	678	691

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS.

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-37

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	9	11	14
ANNUAL RUNOFF	0	0	0	0	0	133	159	199
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	332	397	497
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	451						3000			1287
BASIN	27						180			108
PIPES	30						200			120
RESIDUAL	58									
NET CAPITAL	449									TOTAL 1515

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	33	39	49
SLUDGE (\$1000/YR)	0	0	0	0	0	0	8	9	12
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	42	50	63
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	327	399	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	49	30	0
NET O.+M. =	79.8039								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	449
O.+M. (\$1000)	79
LAND (\$1000)	3
TOTAL (\$1000)	532

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						231	231	231
BASIN						13	13	13
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	42	50	63
TOTAL ANNUAL	0	0	0	0	0	301	309	322

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-38

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	7	9
ANNUAL RUNOFF	0	0	0	0	0	93	112	139
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	232	280	347
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000):

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	398						2650			1136
BASIN	22						150			90
PIPES	451						3000			1800
RESIDUAL	117									
NET CAPITAL	754									
									TOTAL	3026

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	23	28	34
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	7	8
SEWERS (\$1000/YR)	0	0	0	0	0	0	14	14	14
TOTAL (\$1000/YR)	0	0	0	0	0	0	44	49	58
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	330	380	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	49	29	0
NET O.+M. =	78.7742								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	754
O.+M. (\$1000)	78
LAND (\$1000)	2
TOTAL (\$1000)	835

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						204	204	204
BASIN						10	10	10
PIPES						217	217	217
TOTAL O.+M.	0	0	0	0	0	44	49	58
TOTAL ANNUAL	0	0	0	0	0	478	482	491

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CU-39

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	5	11	14	18	20
ANNUAL RUNOFF	0	0	0	85	171	205	256	290
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	427	512	640	725
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1064					3600				503
BASIN	66					223				89
PIPES	887					3000				1199
RESIDUAL	69									
NET CAPITAL	1949									TOTAL 1793

TABLE II : PRESENT WORTH - O.+M. COSTS

		<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
PLANT	(\$1000/YR)	0	0	0	0	42	51	64	72
SLUDGE	(\$1000/YR)	0	0	0	0	10	12	16	18
SEWERS	(\$1000/YR)	0	0	0	0	14	14	14	14
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>66</u>	<u>79</u>	<u>94</u>	<u>105</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	517	611	704	0
PRESENT WORTH (\$1000)									
		0	0	0	0	133	91	53	0
NET D.+M. = 298.98									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1949
O.+M. (\$1000)	298
LAND (\$1000)	5
TOTAL (\$1000)	2253

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					277	277	277	277
BASIN					14	14	14	14
PIPES					217	217	217	217
TOTAL O.+M.	0	0	0	0	68	79	94	105
TOTAL ANNUAL	0	0	0	0	579	590	606	617

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-42

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG):								
1 YR STORM RUNOFF	0	0	0	2	4	4	5	7
ANNUAL RUNOFF	0	0	0	36	72	72	86	107
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	180	180	215	267
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000) -

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	502					1700				237
BASIN	29					100				39
PIPES	59					200				79
RESIDUAL	13									
NET CAPITAL	577									357

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	18	18	21	26
SLUDGE	(\$1000/YR)	0	0	0	0	4	4	5	6
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	23	23	27	34
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	165	180	218	0
PRESENT WORTH (\$1000)									
		0	0	0	0	48	27	16	0
NET O.+M. =		92.6752							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	577
O.+M. (\$1000)	92
LAND (\$1000)	1
TOTAL (\$1000)	671

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					131	131	131	131
BASIN					7	7	7	7
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	23	23	27	34
TOTAL ANNUAL	0	0	0	0	174	174	180	187

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A. CU-43844E45E46E47E54

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	17	34	59	84	106	127	140
ANNUAL RUNOFF	0	240	480	860	1241	1546	1856	2019
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	350	700	1256	1811	2257	2709	2940
TREATMENT PLANT	0	0	292	524	757	943	1132	1228

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	171			269					269	230
BASIN	6460			11100						2219
BASIN	242					820				327
PIPES	1446			2520						503
PIPES	177					600				239
RESIDUAL	136									TOTAL
NET CAPITAL	8381									3522

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	95	202	338	422	506	549
SLUDGE	(\$1000/YR)	0	0	18	34	49	61	73	79
SEWERS	(\$1000/YR)	0	0	12	12	15	15	15	15
TOTAL	(\$1000/YR)	0	0	126	249	403	498	595	645
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	770	1338	3168	3843	4357	0
PRESENT WORTH (\$1000)		0	0	448	555	937	578	332	0
NET O.+M. =	2851.95								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	8381
O.+M. (\$1000)	2851
LAND (\$1000)	389
TOTAL (\$1000)	11330

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			20	20	20	20	20	20
BASIN			803	803	803	803	803	803
BASIN					59	59	59	59
PIPES			182	182	182	182	182	182
PIPES					43	43	43	43
TOTAL O.+M.	0	0	126	249	403	498	595	645
TOTAL ANNUAL	0	0	1133	1256	1513	1608	1705	1794

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A. CU-48C33686

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG) 1 YR STORM RUNOFF	0	34	49	70	72	76	78	78
ANNUAL RUNOFF	0	534	1049	1102	1136	1344	1447	1447
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	1002	2004	2067	2040	3360	3617	3617
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	4837			7600					7600	6513
PLANT EXPANSION	6161				14850					0
SLUDGE HANDLING	279			481						96
BASIN	1006			1730						349
PIPES	9515			16350						3269
RESIDUAL	396								TOTAL	10223
NET CAPITAL	21404									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	66	194	329	389	419	419
SLUDGE	(\$1000/YR)	0	0	10	10	14	16	18	18
SEWERS	(\$1000/YR)	0	0	81	81	81	81	81	81
TOTAL	(\$1000/YR)	0	0	158	286	425	488	519	519

PRESENT VALUE AT BEGIN-  
NING OF PERIOD (\$1000)

PRESENT WORTH (\$1000)

NET O.+M. = 2895.29

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	21404
O.+M. (\$1000)	2895
LAND (\$1000)	130

TOTAL (\$1000) 24429

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			586	586	586	586	586	586
PLANT EXPANSION				1146	1146	1146	1146	1146
SLUDGE HANDLING			34	34	34	34	34	34
BASIN			125	125	125	125	125	125
PIPES			1183	1183	1183	1183	1183	1183
TOTAL O.+M.	0	0	158	286	425	488	519	519
TOTAL ANNUAL	0	0	2088	3363	3502	3565	3596	3596

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, 49E50E37

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	15	31	36	41	57	74	92
ANNUAL RUNOFF	0	232	464	555	646	859	1011	1384
SLUDGE QUANTITIES (GT/YR)								
SEDIMENT BASIN	0	580	1160	1387	1615	2147	2527	3460
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	2779				6700					0
BASIN	261				630					189
PIPES	1220				2940					888
PIPES	1064					3600				1439
RESIDUAL	97									
NET CAPITAL	5236									TOTAL 2916

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	161	161	214	252	346
SLUDGE	(\$1000/YR)	0	0	0	40	40	53	63	86
SEWERS	(\$1000/YR)	0	0	0	14	32	32	32	32
TOTAL	(\$1000/YR)	0	0	0	216	234	301	348	465
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	925	1881	2282	2858	0
PRESENT WORTH (\$1000)		0	0	0	383	556	343	218	0
NET O.+M. =		1502.29							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	5236
O.+M. (\$1000)	1502
LAND (\$1000)	200
TOTAL (\$1000)	6938

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				517	517	517	517	517
BASIN				45	45	45	45	45
PIPES				214	214	214	214	214
PIPES					260	260	260	260
TOTAL O.+M.	0	0	0	216	234	301	348	465
TOTAL ANNUAL	0	0	0	993	1272	1339	1386	1503

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A . CU-510652

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	9	19	22	26	30	32	35
ANNUAL RUNOFF	0	161	322	351	381	441	483	524
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	402	805	878	952	1102	1207	1310
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	4812				11600					0
BASIN	174				420					126
PIPES	82				200					60
RESIDUAL	7									
NET CAPITAL	5062									TOTAL 186

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	95	95	110	120	131
SLUDGE	(\$1000/YR)	0	0	0	23	23	27	30	32
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	120	120	138	151	164
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	492	909	1021	1112	0
PRESENT WORTH (\$1000)		0	0	0	204	268	153	84	0
NET O.+M. =		711.685							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	5062
O.+M. (\$1000)	711
LAND (\$1000)	82
TOTAL (\$1000)	5857

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				895	895	895	895	895
BASIN				30	30	30	30	30
PIPES				14	14	14	14	14
TOTAL O.+M.	0	0	0	120	120	138	151	164
TOTAL ANNUAL	0	0	0	1040	1040	1079	1092	1105

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-51A658

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	5	23	42	48	54	59
ANNUAL RUNOFF	0	32	64	335	606	693	797	867
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	46	93	489	884	1011	1163	1265
TREATMENT PLANT	0	0	39	204	369	422	486	528

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	92			145					145	124
BASIN	203			350						69
BASIN	136					440				183
PIPES	1994			3430						685
PIPES	88					300				119
RESIDUAL	45									TOTAL 1184
NET CAPITAL	2471									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	16	87	159	182	209	228
SLUDGE	(\$1000/YR)	0	0	3	18	33	37	43	47
SEWERS	(\$1000/YR)	0	0	17	17	18	18	18	18
TOTAL	(\$1000/YR)	0	0	37	123	211	238	271	294
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	329	686	1580	1793	1988	0
PRESENT WORTH (\$1000)		0	0	191	284	447	269	151	0
NET O.+M. =	1365.87								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2471
O.+M. (\$1000)	1365
LAND (\$1000)	97
TOTAL (\$1000)	3933

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			11	11	11	11	11	11
BASIN			25	25	25	25	25	25
BASIN					33	33	33	33
PIPES			248	248	248	248	248	248
PIPES					21	21	21	21
TOTAL O.+M.	0	0	37	123	211	238	271	294
TOTAL ANNUAL	0	0	322	408	551	578	611	634

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-93

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	18	36	37	39	41	43	45
ANNUAL RUNOFF	0	253	506	524	543	561	678	775
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	369	738	765	792	848	989	1131
TREATMENT PLANT	0	0	308	319	331	354	413	472

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	116			183					183	156
BASIN	349			600						119
PIPES	276			475						94
RESIDUAL	14									
NET CAPITAL	727								TOTAL	371

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	153	166	180	193	225	258
SLUDGE	(\$1000/YR)	0	0	21	22	22	23	27	31
SEWERS	(\$1000/YR)	0	0	2	2	2	2	2	2
TOTAL	(\$1000/YR)	0	0	177	191	205	219	255	292
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	756	813	1493	1670	1925	0
PRESENT WORTH (\$1000)		0	0	440	337	441	251	247	0
NET O.+M. =		1617.59							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	727
O.+M. (\$1000)	1617
LAND (\$1000)	166
TOTAL (\$1000)	2511

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING			14	14	14	14	14	14
BASIN			43	43	43	43	43	43
PIPES			34	34	34	34	34	34
TOTAL O.+M.	0	0	177	191	205	219	255	292
TOTAL ANNUAL	0	0	269	283	297	311	347	384

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A - CU-59

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	14	28	29	30	30	30	30
ANNUAL RUNOFF	0	263	527	556	585	585	585	585
SLUDGE QUANTITIES (DY/YR)								
SEDIMENT BASIN	0	494	988	1042	1462	1462	1462	1462
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	3500			5500					5500	4713
PLANT EXPANSION	3076					10400				1455
SLUDGE HANDLING	124			195					195	167
BASEIN	3841			6600						1319
PIPES	2619			4500						899
RESIDUAL	331									
NET CAPITAL	12829								TOTAL	8556

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	32	97	169	169	169	169	169
SLUDGE (\$1000/YR)	0	0	4	5	7	7	7	7	7
SEWERS (\$1000/YR)	0	0	22	22	22	22	22	22	22
TOTAL (\$1000/YR)	0	0	60	125	199	199	199	199	199
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	380	664	1400	1400	1400	1400	0
PRESENT WORTH (\$1000)	0	0	221	276	414	210	107	0	0
NET O.+M. =	1230.13								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	12829
O.+M. (\$1000)	1230
LAND (\$1000)	50
TOTAL (\$1000)	14109

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			424	424	424	424	424	424
PLANT EXPANSION			15	15	802	802	802	802
SLUDGE HANDLING			477	477	477	477	477	477
BASEIN			325	325	325	325	325	325
PIPES			60	125	199	199	199	199
TOTAL O.+M.	0	0	1303	1368	2245	2245	2245	2245
TOTAL ANNUAL	0	0	1303	1368	2245	2245	2245	2245

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CU-60661W663E664M

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	81	83	85	87	89	92	92	92
ANNUAL RUNOFF	1484	1543	1603	1631	1659	1725	1725	1725
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	1053	1095	1138	1158	2521	2622	2622	2622
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	6962		7800					7800		5569
PLANT EXPANSION	4436					15000				2099
SLUDGE HANDLING	606		680					680		485
BASIN	13957		17100							1710
PIPES	41354		50667							5066
RESIDUAL	579									
NET CAPITAL	66738									
									TOTAL	14931

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	95	99	364	638	664	664	664	664
SLUDGE (\$1000/YR)	0	5	5	5	12	13	13	13	13
SEWERS (\$1000/YR)	0	253	253	253	253	253	253	253	253
TOTAL (\$1000/YR)	0	354	358	623	904	930	930	930	930
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	1461	2013	3133	6444	6535	6535	0	0
PRESENT WORTH (\$1000)	0	1192	1171	1299	1906	982	499	0	0
NET O.+M. =	7053.27								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	66738
O.+M. (\$1000)	7053
LAND (\$1000)	20
TOTAL (\$1000)	73811

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		602	602	602	602	602	602	602
PLANT EXPANSION					1157	1157	1157	1157
SLUDGE HANDLING		52	52	52	52	52	52	52
BASIN		1238	1238	1238	1238	1238	1238	1238
PIPES		3668	3668	3668	3668	3668	3668	3668
TOTAL O.+M.	0	354	358	623	904	930	930	930
TOTAL ANNUAL	0	5915	5919	6184	7623	7649	7649	7649

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A . CU-61E662

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	23	47	49	51	54	54	54
ANNUAL RUNOFF	0	340	681	738	795	958	958	958
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	241	483	523	1208	1456	1456	1456
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1209			1900					1900	1628
PLANT EXPANSION	1659				4000					0
SLUDGE HANDLING	327			514					514	440
BASIN	5965			10250						2049
PIPES	116			200						39
RESIDUAL	161									
NET CAPITAL	9116									4158

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	42	164	305	368	368	368	368
SLUDGE (\$1000/YR)	0	0	2	2	6	7	7	7	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	45	168	312	377	377	377	377
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	438	985	2421	2648	2648	0	0
PRESENT WORTH (\$1000)	0	0	255	408	716	398	202	0	0
NET O.+M. =	1980.71								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	9116
O.+M. (\$1000)	1980
LAND (\$1000)	77
TOTAL (\$1000)	11174

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			146	146	146	146	146	146
PLANT EXPANSION				308	308	308	308	308
SLUDGE HANDLING			39	39	39	39	39	39
BASIN			742	742	742	742	742	742
PIPES			14	14	14	14	14	14
TOTAL O.+M.	0	0	45	168	312	377	377	377
TOTAL ANNUAL	0	0	988	1419	1564	1628	1628	1628

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CU-63M

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	5	11	11	12	13	13	13
ANNUAL RUNOFF	0	97	194	200	207	233	233	233
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	181	363	375	517	582	582	582
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	2546			4000					4000	3427
PLANT EXPANSION	2898					9800				1371
SLUDGE HANDLING	136			215					215	184
BASEIN	1489			2560						511
PIPES	116			200						39
RESIDUAL	214								TOTAL	5536
NET CAPITAL	6973									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	12	35	60	67	67	67
SLUDGE	(\$1000/YR)	0	0	1	1	2	2	2	2
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	14	38	63	71	71	71
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	108	208	474	502	502	0
PRESENT WORTH (\$1000)		0	0	63	86	140	75	38	0
NET O.+M. =									404.032

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	6973
O.+M. (\$1000)	404
LAND (\$1000)	28
TOTAL (\$1000)	7405

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			308	308	308	308	308	308
PLANT EXPANSION					756	756	756	756
SLUDGE HANDLING			16	16	16	16	16	16
BASEIN			185	185	185	185	185	185
PIPES			14	14	14	14	14	14
TOTAL O.+M.	0	0	14	38	63	71	71	71
TOTAL ANNUAL	0	0	540	563	1345	1353	1353	1353

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

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WASTEWATER MANAGEMENT STUDY FOR CLEVELAND-AKRON AND THREE RIVER--ETC(U)

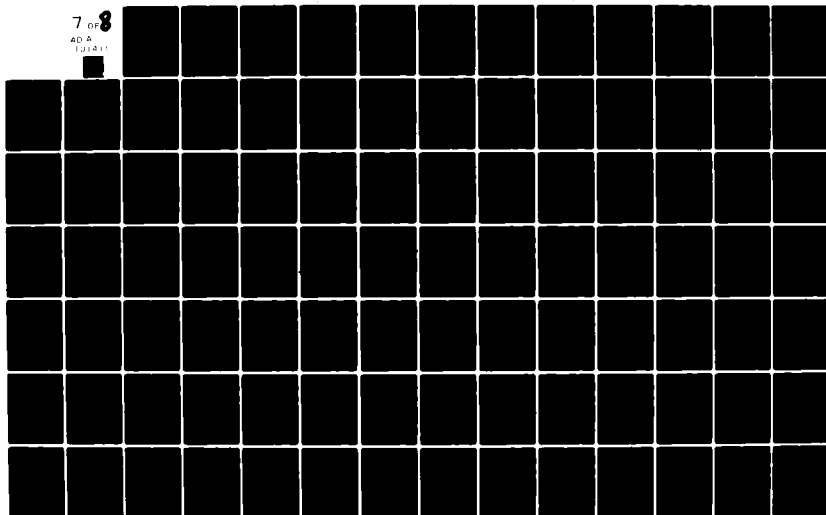
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**STORMWATER TREATMENT PLANT**
**CORPS OF ENGINEERS - SURVEY SCOPE STUDY**
**PLAN A - CU-645E**

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	18	18	18	18	18	18	18	18
ANNUAL RUNOFF	347	347	347	347	347	347	347	347
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	246	246	246	246	527	527	527	527
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

**TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)**

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	3659		4100					4100		2927
PLANT EXPANSION	2662					9000				1259
SLUDGE HANDLING	103		116					116		82
BASIN	2791		3420							342
PIPES	489		600							60
RESIDUAL	181									
NET CAPITAL	9525									
									TOTAL	4672

**TABLE II : PRESENT WORTH - O.+M. COSTS**

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	21	21	77	133	133	133	133	133
SLUDGE (\$1000/YR)	0	1	1	1	2	2	2	2	2
SEWERS (\$1000/YR)	0	2	2	2	2	2	2	2	2
TOTAL (\$1000/YR)	0	25	25	81	139	139	139	139	139
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	105	220	453	977	977	977	977	0
PRESENT WORTH (\$1000)	0	86	128	167	289	147	74	0	0
NET O.+M. =	913.497								

**TABLE III : TOTAL PRESENT WORTH**

CAPITAL (\$1000)	9525
O.+M. (\$1000)	913
LAND (\$1000)	23
TOTAL (\$1000)	10461

**TABLE IV : ANNUAL COSTS (\$1000/YR)**

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		316	316	316	316	316	316	316
PLANT EXPANSION					694	694	694	694
SLUDGE HANDLING		8	8	8	8	8	8	8
BASIN		247	247	247	247	247	247	247
PIPES		43	43	43	43	43	43	43
TOTAL O.+M.	0	25	25	81	139	139	139	139
TOTAL ANNUAL	0	642	642	698	1450	1450	1450	1450

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-64NE65

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	8	8	8	8	8	8	8	8
ANNUAL RUNOFF	172	172	172	172	172	172	172	172
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	122	122	122	122	261	261	261	261
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	3124		3500					3500		2498
PLANT EXPANSION	4436					15000				2099
SLUDGE HANDLING	190		213					213		152
BASIN	1167		1430							143
PIPES	1183		1450							145
RESIDUAL	195									
NET CAPITAL	9906								TOTAL	5039

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	10	10	38	66	66	66	66	66
SLUDGE (\$1000/YR)	0	0	0	0	1	1	1	1	1
SEWERS (\$1000/YR)	0	7	7	7	7	7	7	7	7
TOTAL (\$1000/YR)	0	18	18	46	74	74	74	74	74
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	75	132	248	525	525	525	525	0
PRESENT WORTH (\$1000)	0	61	77	102	155	78	40	0	0
NET O.+M. =	516.794								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	9906
O.+M. (\$1000)	516
LAND (\$1000)	20
TOTAL (\$1000)	10443

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT		270	270	270	270	270	270	270
PLANT EXPANSION					1157	1157	1157	1157
SLUDGE HANDLING		16	16	16	16	16	16	16
BASIN		103	103	103	103	103	103	103
PIPES		104	104	104	104	104	104	104
TOTAL O.+M.	0	18	18	46	74	74	74	74
TOTAL ANNUAL	0	513	513	541	1727	1727	1727	1727

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT CORPS. OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CU-66

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	15	31	32	34	37	37	37
ANNUAL RUNOFF	0	219	438	476	514	643	643	643
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	410	821	892	1285	1607	1607	1607
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	954			1500					1500	1285
PLANT EXPANSION	976					3300				461
BASIN	171			295						58
PIPES	3142			5400						1079
RESIDUAL	111								TOTAL	2886
NET CAPITAL	5133									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	15	67	128	160	160	160
SLUDGE	(\$1000/YR)	0	0	20	22	32	40	40	40
SEWERS	(\$1000/YR)	0	0	26	26	26	26	26	26
TOTAL	(\$1000/YR)	0	0	62	117	187	227	227	227
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	369	624	1459	1600	1600	0
PRESENT WORTH (\$1000)		0	0	214	259	431	240	122	0
NET O.+M. =	1268.76								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	5133
O.+M. (\$1000)	1268
LAND (\$1000)	79
TOTAL (\$1000)	6481

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			115	115	115	115	115	115
PLANT EXPANSION					254	254	254	254
BASIN			21	21	21	21	21	21
PIPES			390	390	390	390	390	390
TOTAL O.+M.	0	0	62	117	187	227	227	227
TOTAL ANNUAL	0	0	590	645	970	1010	1010	1010

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A, CU-67 &amp; 71

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	7	15	18	21	27	32	39
ANNUAL RUNOFF	0	116	232	272	313	405	486	579
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	290	580	681	782	1012	1215	1447
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	1991				4800					0
BASIN	124				300					90
PIPES	518				1250					375
RESIDUAL	18									
NET CAPITAL	2616									TOTAL 465

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	78	78	101	121	144
SLUDGE	(\$1000/YR)	0	0	0	19	19	25	30	36
SEWERS	(\$1000/YR)	0	0	0	6	6	6	6	6
TOTAL	(\$1000/YR)	0	0	0	104	104	132	158	187
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	426	831	1021	1212	0
PRESENT WORTH (\$1000)		0	0	0	177	246	153	92	0
NET O.+M. =									669.393

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2616
O.+M. (\$1000)	669
LAND (\$1000)	44
TOTAL (\$1000)	3329

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				370	370	370	370	370
BASIN				21	21	21	21	21
PIPES				90	90	90	90	90
TOTAL O.+M.	0	0	0	104	104	132	158	187
TOTAL ANNUAL	0	0	0	586	586	615	640	669

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-68

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	12	25	25	25	25	25	25
ANNUAL RUNOFF	0	248	496	496	496	496	496	496
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	465	930	930	1240	1240	1240	1240
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	3246			5100					5100	4370
PLANT EXPANSION	3253					11000				1539
SLUDGE HANDLING	180			283					283	242
BASIN	2648			4550						909
PIPES	4033			6930						1385
RESIDUAL	327								TOTAL	8449
NET CAPITAL	13033									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	30	87	143	143	143	143	143
SLUDGE (\$1000/YR)	0	0	4	4	6	6	6	6	6
SEWERS (\$1000/YR)	0	0	34	34	34	34	34	34	34
TOTAL (\$1000/YR)	0	0	70	126	184	184	184	184	184
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	403	638	1297	1297	1297	1297	0
PRESENT WORTH (\$1000)	0	0	234	264	383	195	99	99	0
NET O.+M. =	1177.3								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	13033
O.+M. (\$1000)	1177
LAND (\$1000)	45
TOTAL (\$1000)	14255

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			393	393	393	393	393	393
PLANT EXPANSION			21	21	849	849	849	849
SLUDGE HANDLING			329	329	21	21	21	21
BASIN			501	501	329	329	329	329
PIPES			70	126	501	501	501	501
TOTAL O.+M.	0	0	70	126	184	184	184	184
TOTAL ANNUAL	0	0	1316	1373	2280	2280	2280	2280

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-69670

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	42	84	87	90	95	99	101
ANNUAL RUNOFF	0	592	1184	1226	1268	1502	1667	1832
SLUDGE QUANTITIES (DY/YR)								
SEDIMENT-BASIN	0	1110	2220	2298	3170	3755	4167	4580
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	5092			8000					8000	6855
PLANT EXPANSION	4664					15770				2207
SLUDGE HANDLING	70			110					110	94
BASIN	11290			19400						3879
PIPES	2362			4060						811
RESIDUAL	537								TOTAL	13850
NET CAPITAL	22943									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	73	215	367	435	483	531
SLUDGE	(\$1000/YR)	0	0	11	11	15	18	20	22
SEWERS	(\$1000/YR)	0	0	20	20	20	20	20	20
TOTAL	(\$1000/YR)	0	0	104	247	403	474	524	574
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)									
		0	0	722	1335	3085	3509	3859	0
PRESENT WORTH (\$1000)									
		0	0	420	554	912	527	294	0
NET O.+M. =		2709.74							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	22943
O.+M. (\$1000)	2709
LAND (\$1000)	120

TOTAL (\$1000) 25772

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			617	617	617	617	617	617
PLANT EXPANSION					1217	1217	1217	1217
SLUDGE HANDLING			8	8	8	8	8	8
BASIN			1404	1404	1404	1404	1404	1404
PIPES			293	293	293	293	293	293
TOTAL O.+M.	0	0	104	247	403	474	524	574
TOTAL ANNUAL	0	0	2429	2572	3945	4015	4066	4116

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-73674

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	9	12
ANNUAL RUNOFF	0	0	0	0	0	126	153	191
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	315	382	477
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	451						3000			1287
BASIN	27						180			108
PIPES	215						1430			858
RESIDUAL	87									
NET CAPITAL	605									2253

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	31	38	47
SLUDGE (\$1000/YR)	0	0	0	0	0	0	7	9	11
SEWERS (\$1000/YR)	0	0	0	0	0	0	7	7	7
TOTAL (\$1000/YR)	0	0	0	0	0	0	46	54	66
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	356	427	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	53	32	0
NET O.+M. =	86.281								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	605
O.+M. (\$1000)	86
LAND (\$1000)	3
TOTAL (\$1000)	695

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						231	231	231
BASIN						13	13	13
PIPES						103	103	103
TOTAL O.+M.	0	0	0	0	0	46	54	66
TOTAL ANNUAL	0	0	0	0	0	394	403	413

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN A . CU-75676

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	10	11	14
ANNUAL RUNOFF	0	0	0	0	0	154	185	230
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	385	462	575
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	496						3300			1415
BASIN	30						200			120
PIPES	186						1240			744
TREATMENT PLANT	0							0		0
RESIDUAL	88									
NET CAPITAL	624									TOTAL 2279

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	38	46	57
SLUDGE (\$1000/YR)	0	0	0	0	0	0	9	11	14
SEWERS (\$1000/YR)	0	0	0	0	0	0	6	6	6
TOTAL (\$1000/YR)	0	0	0	0	0	0	54	64	78
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	415	498	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	62	39	0
NET O.+M. =	100.624								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	624
O.+M. (\$1000)	100
LAND (\$1000)	4
TOTAL (\$1000)	729

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						254	254	254
BASIN						14	14	14
PIPES						89	89	89
TREATMENT PLANT						0	0	0
TOTAL O.+M.	0	0	0	0	0	54	64	78
TOTAL ANNUAL	0	0	0	0	0	413	423	437

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN A, CU-77

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	6	8
ANNUAL RUNOFF	0	0	0	0	0	87	105	132
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	217	262	330
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	375						2500			1072
BASIN	22						150			90
PIPES	30						200			120
RESIDUAL	49									
NET CAPITAL	378									1282

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	21	26	33
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	6	8
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	28	33	42
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	217	267	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	32	20	0
NET O.+M. =	53.1537								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	378
O.+M. (\$1000)	53
LAND (\$1000)	2
TOTAL (\$1000)	434

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						192	192	192
BASIN						10	10	10
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	28	33	42
TOTAL ANNUAL	0	0	0	0	0	246	252	260

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A - CU-78679681

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	15	18	22
ANNUAL RUNOFF	0	0	0	0	0	224	268	325
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	327	391	474
TREATMENT PLANT	0	0	0	0	0	136	163	198

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000):

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	15						103			44
BASIN	60						400			240
PIPES	827						5500			3300
RESIDUAL	139									
NET CAPITAL	763									3584

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	105	124	153
SLUDGE (\$1000/YR)	0	0	0	0	0	0	13	15	18
SEWERS (\$1000/YR)	0	0	0	0	0	0	27	27	27
TOTAL (\$1000/YR)	0	0	0	0	0	0	144	169	200
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	1111	1299	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	167	99	0
NET O.+M. =	266-465								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	763
O.+M. (\$1000)	266
LAND (\$1000)	14
TOTAL (\$1000)	1044

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING						7	7	7
BASIN						28	28	28
PIPES						398	398	398
TOTAL O.+M.	0	0	0	0	0	144	169	200
TOTAL ANNUAL	0	0	0	0	0	581	605	635

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-82

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	1	2
ANNUAL RUNOFF	0	0	0	0	0	24	29	36
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	60	72	90
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	203						1350			579
BASIN	12						80			48
PIPES	90						400			360
RESIDUAL	38									
NET CAPITAL	267									TOTAL 987

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	6	7	9
SLUDGE (\$1000/YR)	0	0	0	0	0	0	1	1	2
SEWERS (\$1000/YR)	0	0	0	0	0	0	2	2	2
TOTAL (\$1000/YR)	0	0	0	0	0	0	10	12	14
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	79	92	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	11	7	0
NET O.+M. =	18.9763								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	267
O.+M. (\$1000)	18
LAND (\$1000)	1
TOTAL (\$1000)	286

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						104	104	104
BASIN						5	5	5
PIPES						43	43	43
TOTAL O.+M.	0	0	0	0	0	10	12	14
TOTAL ANNUAL	0	0	0	0	0	163	165	167

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-83

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	3	7	7	7	7	8	8
ANNUAL RUNOFF	0	48	97	98	100	105	113	122
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	70	141	143	146	153	164	170
TREATMENT PLANT	0	0	59	60	61	64	68	74

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	23				56					0
BASIN	82				200					60
PIPES	788				1900					570
RESIDUAL	24									
NET CAPITAL	870									TOTAL 630

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	60	60	63	68	73
SLUDGE	(\$1000/YR)	0	0	0	6	6	7	7	8
SEWERS	(\$1000/YR)	0	0	0	9	9	9	9	9
TOTAL	(\$1000/YR)	0	0	0	76	76	79	85	91
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	314	349	380	420	0
PRESENT WORTH (\$1000)									
		0	0	0	130	162	87	47	0
NET O.+M. = 427.754									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	870
O.+M. (\$1000)	427
LAND (\$1000)	4
TOTAL (\$1000)	1301

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				4	4	4	4	4
BASIN				14	14	14	14	14
PIPES				137	137	137	137	137
TOTAL O.+M.	0	0	0	76	76	79	85	91
TOTAL ANNUAL	0	0	0	232	232	236	241	247

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN A, CU-84

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	5	5	6	6	6	7
ANNUAL RUNOFF	0	39	78	79	81	85	92	98
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	56	113	116	118	124	134	143
TREATMENT PLANT	0	0	47	48	49	51	56	59

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	17				43					0
BASIN	78				190					57
PIPES	1016				2450					735
RESIDUAL	30									
NET CAPITAL	1082									792

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	48	48	51	55	59
SLUDGE	(\$1000/YR)	0	0	0	5	5	5	6	6
SEWERS	(\$1000/YR)	0	0	0	12	12	12	12	12
TOTAL	(\$1000/YR)	0	0	0	66	66	69	74	78
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	273	477	503	534	0
PRESENT WORTH (\$1000)		0	0	0	113	141	75	40	0
NET O.+M. =	371-277								

TABLE III : TOTAL PRESENT WORTH

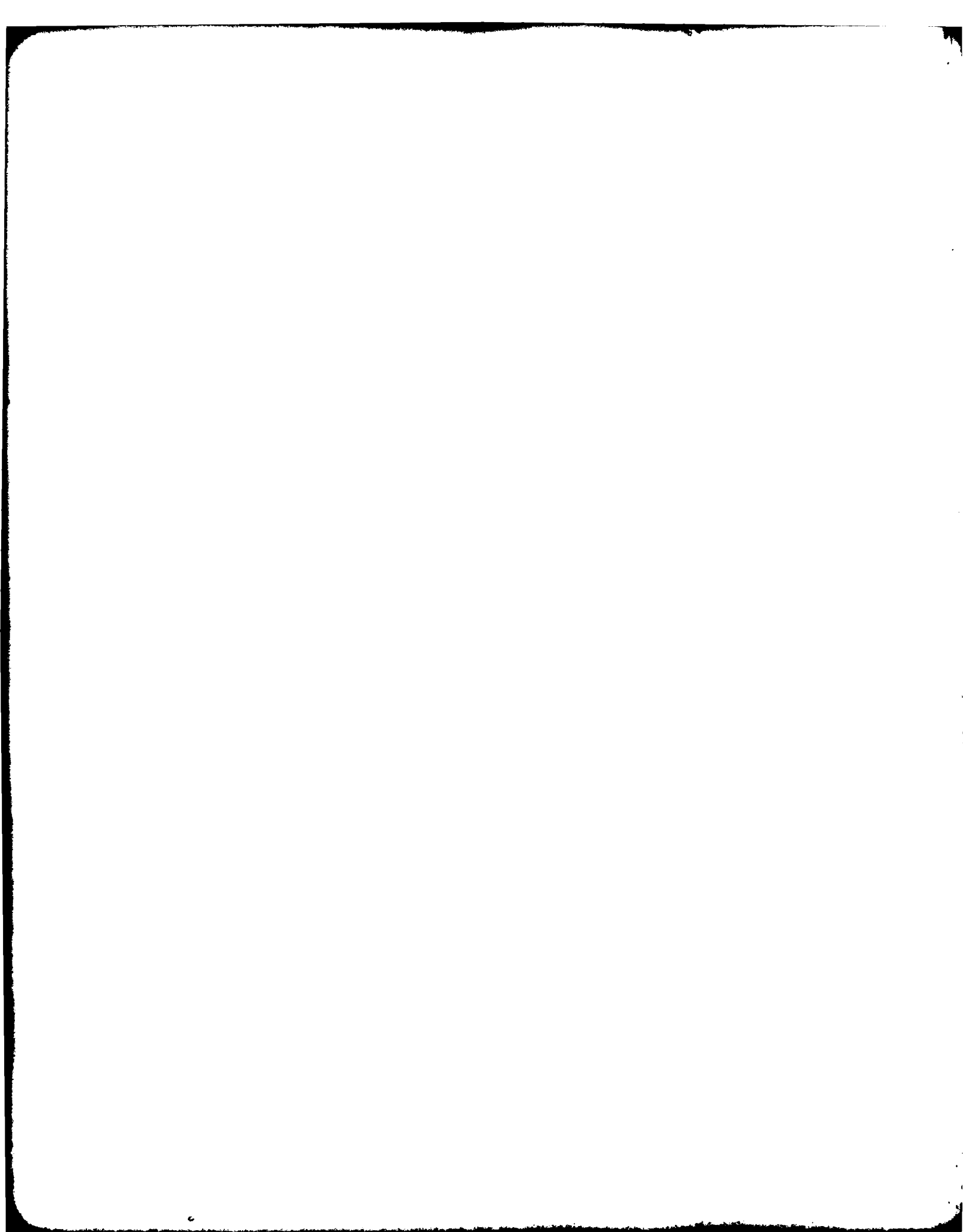
CAPITAL (\$1000)	1082
O.+M. (\$1000)	371
LAND (\$1000)	3
TOTAL (\$1000)	1456

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING				3	3	3	3	3
BASIN				13	13	13	13	13
PIPES				177	177	177	177	177
TOTAL O.+M.	0	0	0	66	66	69	74	78
TOTAL ANNUAL	0	0	0	261	261	263	268	272

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS



## APPENDIX B

This appendix includes all computer printout sheets for the municipal plants and stormwater districts of Plan B except for those municipal plants or stormwater districts which are identical in Plan A. Those which are identical to Plan A are listed below. See Appendix A for these associated computer sheets.

CH - 1	LE - 1	CU - 13	CU - 50
- 2	- 2	- 14	- 51A
- 3	- 3	- 15	- 54
- 4	- 4	- 16	- 55
- 5	- 5	- 17	- 56
- 6	- 6	- 18	- 57
- 9	- 7	- 19	- 58
- 10	- 8	- 20	- 60
- 11	- 9	- 21	- 61W
R - 1	- 10	- 22	- 61E
- 3	- 11	- 23	- 62
- 4	- 12	- 24	- 63E
- 5		- 25	- 64W
- 6	CU - 1	- 32	- 64NE
- 7	- 2	- 33	- 65
- 8N	- 3	- 34A	- 66
- 10	- 4A	- 34B	- 68
- 12	- 4B,C,D	- 34D	- 69
- 13	- 5	- 35	- 70
- 14	- 6	- 43	- 53
- 15	- 7	- 44	
- 16	- 8	- 45	
- 17	- 9	- 46	
- 18	- 10	- 47	
- 21	- 11	- 48	
- 22	- 12	- 49	

Lakewood  
Willoughby-Eastlake  
Kent  
Akron

Euclid  
Easterly  
Westerly  
Rocky River

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B - LIVERPOOL

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	3727	7323	10920	13300	15680	19769	24357	33333
FLOW (MGD)								
DOMESTIC	0.41	0.86	1.31	1.64	1.96	2.57	3.41	5.00
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.41	0.86	1.31	1.64	1.96	2.57	3.41	5.00
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	62		70					70		49
SEWERS	1984		2432							243
RESIDUAL	11								TOTAL	293
NET CAPITAL	2036									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	48	2	3	4	5	7	9	13
SLUDGE	(\$1000/YR)	5	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	12	12	12	12	12	12	12
-----	(\$1000/YR)	53	14	15	16	17	19	21	25
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		88	62	66	70	128	142	166	0
PRESENT WORTH (\$1000)		88	50	38	29	38	21	12	0
NET O.+M. =		279							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2036
O.+M. (\$1000)	279
LAND (\$1000)	0
TOTAL (\$1000)	279

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		5	5	5	5	5	5	5
SEWERS		176	176	176	176	176	176	176
TOTAL O.+M.	53	14	15	16	17	19	21	25
TOTAL ANNUAL	53	175	177	178	177	200	202	207

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BORROWED INDEBTEDNESS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B, SOUTHERLY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	546902	631563	716224	874442	1032660	1150890	1219966	1228581
FLOW (MGD)								
DOMESTIC	88.62	99.70	110.78	132.98	155.19	177.19	194.57	201.92
INDUSTRIAL	13.03	15.29	17.55	21.02	24.49	25.48	26.45	27.45
TOTAL	101.65	114.99	128.33	154.00	179.68	202.67	221.02	229.37
SLUDGE (TPD)								
GENERATED	107.75	121.89	136.03	163.25	204.84	231.04	251.96	261.48
DISCHARGED	68.96	78.01	87.06	104.48	131.09	147.87	161.26	167.35

TREATMENT PLANT TYPE : ADVANCED BIOLOGICAL PLANT

SLUDGE HANDLING TYPE : STRIP MINE APPLICATION

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	16563						110130			47245
EXPAND TO LEVEL 1	49092		55000					55000		39269
EXPAND TO LEVEL 2	36511				88000					0
SLUDGE FACILITIES	14281		16000					16000		11423
SLUDGE FACILITIES	5620					19000				2659
SEWERS	16132		19765							1976
SEWERS	13953			23975						4794
SEWERS	4728					15986				6394
RESIDUAL	4414									
NET CAPITAL	152469									TOTAL 113765

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	6121	6925	7728	11382	15739	17753	19361	20092
SLUDGE	(\$1000/YR)	1179	1334	1489	1042	373	421	459	477
SEWERS	(\$1000/YR)	0	98	218	218	298	298	298	298
TOTAL	(\$1000/YR)	7301	8358	9436	12644	16412	18474	20119	20868
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		20548	36482	45267	59567	122512	135532	143941	0
PRESENT WORTH (\$1000)		20548	29776	26345	24714	36239	20384	10997	0
NET O.+M. =		169006.							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	152469
O.+M. (\$1000)	169006
LAND (\$1000)	2780
TOTAL (\$1000)	324255

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT						8502	8502	8502
EXPAND TO LEVEL 1		4245	4245	4245	4245	4245	4245	4245
EXPAND TO LEVEL 2				6793	6793	6793	6793	6793
SLUDGE FACILITIES		1235	1235	1235	1235	1235	1235	1235
SLUDGE FACILITIES				1466	1466	1466	1466	1466
SEWERS		1430	1430	1430	1430	1430	1430	1430
SEWERS			1735	1735	1735	1735	1735	1735
SEWERS				1157	1157	1157	1157	1157
TOTAL O.+M.	7301	8358	9436	12644	16412	18474	20119	20868
TOTAL ANNUAL	7301	15270	18034	23035	34473	45141	46087	47436

## WASTEWATER TREATMENT PLANT

## COMPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B - AURORA CENTRAL

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1990	2563	3136	4842	6549	11600	14020	16285
FLOW (MGD)								
DOMESTIC	0.22	0.30	0.38	0.60	0.82	1.51	1.96	2.44
INDUSTRIAL	0.00	0.11	0.22	0.36	0.50	0.22	0.35	0.54
TOTAL	0.22	0.41	0.60	0.96	1.32	1.73	2.31	2.98
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	46		52					52		37
SEWERS	558			960						191
SEWERS	319					1080				431
RESIDUAL	25									
NET CAPITAL	898									661

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	30	1	2	3	4	6	8	10
SLUDGE	(\$1000/YR)	2	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	4	4	10	10	10	10
<hr/>		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
TOTAL	(\$1000/YR)	32	1	6	8	15	16	18	21
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		3	17	31	47	110	123	139	0
 PRESENT WORTH (\$1000)		 3	 14	 18	 19	 32	 18	 10	 0
 NET O.+M. =		 157							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	898
O.+M. (\$1000)	157
LAND (\$1000)	30
TOTAL (\$1000)	1085

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		4	4	4	4	4	4	4
SEWERS			69	69	69	69	69	69
SEWERS				78	78	78	78	78
TOTAL O.+M.	32	1	6	8	15	16	18	21
TOTAL ANNUAL	32	5	30	81	166	168	170	172

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B - FOWLENS MILL

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	3320	4500	5340	6190	7040	8780	11000	13200
FLOW (MGD)								
DOMESTIC	0.42	1.53	0.64	0.76	0.88	1.14	1.54	1.98
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.42	1.53	0.64	0.76	0.88	1.14	1.54	1.98
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	35		40					40		28
SEWERS	799		979							97
RESIDUAL	4									
NET CAPITAL	329									126

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	61	2	2	3	3	4	6	8
SLUDGE	(\$1000/YR)	4	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	4	4	4	4	4	4	4
TOTAL	(\$1000/YR)	66	7	7	8	8	9	11	13
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		96	30	32	34	65	75	88	0
PRESENT WORTH (\$1000)									
		96	24	18	14	19	11	6	0
NET O.+M. = 192									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	329
O.+M. (\$1000)	192
LAND (\$1000)	20
TOTAL (\$1000)	541

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		3	3	3	3	3	3	3
SEWERS		70	70	70	70	70	70	70
TOTAL O.+M.	66	7	7	8	9	9	11	13
TOTAL ANNUAL	66	81	81	82	82	83	85	87

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN 5, NEWHURRY TWP

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	3000	3585	4170	4845	5520	6910	8090	10300
FLOW (MGD)								
DOMESTIC	0.33	0.41	0.50	0.59	0.69	0.90	1.13	1.54
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.33	0.41	0.50	0.59	0.69	0.90	1.13	1.54
SLUDGE (TPO)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	30		34					34		24
SEWERS	211					715				285
RESIDUAL	12									
NET CAPITAL	229									310

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	48	2	2	3	3	4	6	8	
SLUDGE (\$1000/YR)	3	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	3	3	3	3	3
TOTAL (\$1000/YR)	52	2	2	3	7	8	9	12	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		71	10	12	21	55	64	76	0
PRESENT WORTH (\$1000)		71	8	7	9	16	9	5	0
NET O.+M. =	127								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	229
O.+M. (\$1000)	127
LAND (\$1000)	15
TOTAL (\$1000)	371

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		2	2	2	2	2	2	2
SEWERS					51	51	51	51
TOTAL O.+M.	52	2	2	3	7	8	9	12
TOTAL ANNUAL	52	4	5	5	61	62	64	66

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, CHAGHIN FALLS

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	7591	11344	15097	22705	30313	38564	45924	51296
FLOW (MGD)								
DOMESTIC	0.04	1.33	1.82	2.78	3.75	5.02	6.43	7.69
INDUSTRIAL	0.15	0.16	0.16	0.16	0.16	0.17	0.17	0.18
TOTAL	0.99	1.49	1.96	2.94	3.91	5.19	6.60	7.87
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	83		94					94		67
SEWERS	3160		3872							387
SEWERS	195			336						67
SEWERS	108						720			432
RESIDUAL	36								TOTAL	953
NET CAPITAL	3511									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	123	3	4	6	8	11	14	17
SLUDGE	(\$1000/YR)	6	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	19	21	21	21	24	24	24
TOTAL	(\$1000/YR)	130	22	25	27	29	35	39	41
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		199	98	108	117	230	263	284	0
PRESENT WORTH (\$1000)		199	80	63	48	68	39	21	0
NET O.+M. =	520								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3511
O.+M. (\$1000)	520
LAND (\$1000)	0
TOTAL (\$1000)	4031

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		7	7	7	7	7	7	7
SEWERS		230	280	280	280	280	280	280
SEWERS			24	24	24	24	24	24
SEWERS						52	52	52
TOTAL O.+M.	130	22	25	27	29	35	39	41
TOTAL ANNUAL	130	310	337	339	341	400	403	405

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN 4, FAIRMOUNT ROAD

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	628	2550	4485	8457	12430	16450	20030	22600
FLOW (MGD)								
DOMESTIC	0.07	0.31	0.54	1.05	1.55	2.14	2.80	3.40
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.07	0.31	0.54	1.05	1.55	2.14	2.80	3.40
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	49		50					56		39
SEWERS	587		720							72
SEWERS	147					498				199
RESIDUAL	12									
NET CAPITAL	772									TOTAL 311

TABLE II : PRESENT WORTH - O.+M. COSTS

		<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
PLANT	(\$1000/YR)	9	1	1	3	5	7	9	11
SLUDGE	(\$1000/YR)	0	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	3	3	3	6	6	6	6
TOTAL	(\$1000/YR)	9	4	5	7	11	13	15	17
<hr/>									
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		17	20	25	37	85	99	114	0
PRESENT WORTH (\$1000)		17	16	14	15	25	15	8	0
NET O.+M. =	113								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	772
O.+M. (\$1000)	113
LAND (\$1000)	0
TOTAL (\$1000)	885

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		4	4	4	4	4	4	4
SEWERS		52	52	52	52	52	52	52
SEWERS					36	36	36	36
TOTAL O.+M.	9	4	5	7	11	13	15	17
TOTAL ANNUAL	9	61	61	63	103	105	107	109

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BORROW INTERESTS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN 9. CHAGKIN E. BRANCH

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	4420	5205	5990	6985	7980	9600	11340	13020
FLOW (MGD)								
DOMESTIC	0.49	0.61	0.72	0.86	1.00	1.25	1.58	1.95
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.49	0.61	0.72	0.86	1.00	1.25	1.58	1.95
SLUDGE (T/D)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	35		40					40		28
SEWERS	668		819							81
SEWERS	315			542						108
RESIDUAL	8								TOTAL	218
NET CAPITAL	1011									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	71	2	3	3	4	5	6	8
SLUDGE	(\$1000/YR)	5	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	4	6	6	6	6	6	6
<hr/>									
TOTAL	(\$1000/YR)	76	6	9	10	11	12	13	15
<hr/>									
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		107	34	42	44	82	91	102	0
PRESENT WORTH (\$1000)		107	27	24	18	24	13	7	0
NET C.+M. =		224							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1011
O.+M. (\$1000)	224
LAND (\$1000)	20
TOTAL (\$1000)	1255

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		3	3	3	4	5	6	8
SEWERS		50	59	59	59	59	59	59
SEWERS			39	39	39	39	39	39
TOTAL O.+M.	76	6	9	10	11	12	13	15
TOTAL ANNUAL	76	69	111	112	113	115	115	116

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING DEBT OR INTEREST ON DEBT  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVLY SCOPE STUDY

## PLAN B - BUTTERNUT CREEK

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	2160	2630	3080	3540	4000	5080	6360	7800
FLOW (MGD)								
DOMESTIC	0.24	0.31	0.37	0.44	0.50	0.66	0.89	1.17
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.24	0.31	0.37	0.44	0.50	0.66	0.89	1.17
SLUDGE (TPO)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	24		28					28		19
SEWERS	391		480							48
SEWERS	272			468						93
RESIDUAL	6								TOTAL	161
NET CAPITAL	682									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	35	2	2	2	2	3	4	5	7
SLUDGE (\$1000/YR)	2	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	2	4	4	4	4	4	4	4
TOTAL (\$1000/YR)	37	4	7	7	7	8	9	10	12
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	54	23	30	32	60	69	80	0	0
PRESENT WORTH (\$1000)	54	19	17	13	17	10	6	0	0
NET O.+M. =	139								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	682
O.+M. (\$1000)	139
LAND (\$1000)	12
TOTAL (\$1000)	833

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		2	2	2	2	2	2	2
SEWERS		34	34	34	34	34	34	34
SEWERS			33	33	33	33	33	33
TOTAL O.+M.	37	4	7	7	8	9	10	12
TOTAL ANNUAL	37	41	77	78	78	79	81	33

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B , EAST CLARIDON

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	730	950	1170	1425	1680	2380	2780	3200
FLCM (MGD)								
DOMESTIC	0.08	0.11	0.14	0.17	0.21	0.31	0.39	0.48
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.08	0.11	0.14	0.17	0.21	0.31	0.39	0.48
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	16		18					18		12
SEWERS	97		120							12
RESIDUAL	0									
NET CAPITAL	113									24

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	11	1	1	1	2	3	3	4
SLUDGE	(\$1000/YR)	1	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	12	1	1	2	2	3	4	5
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		17	7	8	10	22	28	34	0
PRESENT WORTH (\$1000)		17	6	5	4	6	4	2	0
NET O.+M. =	46								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	113
O.+M. (\$1000)	46
LAND (\$1000)	5
TOTAL (\$1000)	164

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		1	1	1	1	1	1	1
SEWERS		5	8	8	8	8	8	8
TOTAL O.+M.	12	1	1	2	2	3	4	5
TOTAL ANNUAL	12	11	12	12	12	13	14	15

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B, BURTON

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	2800	3950	5100	6350	7600	8700	11200	13300
FLOW (MGD)								
DOMESTIC	0.31	0.46	0.61	0.78	0.95	1.13	1.57	1.99
INDUSTRIAL	0.64	0.70	0.77	0.84	0.92	1.15	1.38	1.62
TOTAL	0.95	1.16	1.38	1.62	1.87	2.28	2.95	3.61
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	50		57					57		40
SEWERS	791		970							97
SEWERS	286			492						98
SEWERS	70					240				95
RESIDUAL	12									
NET CAPITAL	1187									332

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	128	3	4	5	6	7	9	11	
SLUDGE (\$1000/YR)	8	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	4	7	7	8	8	8	8	8
TOTAL (\$1000/YR)	138	8	11	12	14	15	18	20	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	194	42	50	55	107	120	135	0	
PRESENT WORTH (\$1000)	194	34	29	23	31	18	10	0	
NET O.+M. =	339								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1187
O.+M. (\$1000)	339
LAND (\$1000)	36
TOTAL (\$1000)	1562

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		4	4	4	4	4	4	4
SEWERS		70	70	70	70	70	70	70
SEWERS			35	35	35	35	35	35
SEWERS					17	17	17	17
TOTAL O.+M.	138	8	11	12	14	15	18	20
TOTAL ANNUAL	138	83	122	122	142	143	145	148

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B - AUGURN TWP.

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1550	1940	2330	2725	3120	4000	4930	5600
FLOW (MGD)								
DOMESTIC	0.17	0.22	0.28	0.33	0.39	0.53	0.69	0.84
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.17	0.22	0.28	0.33	0.39	0.53	0.69	0.84
SLUDGE (TPO)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT SEWERS	22 195		25	336				25		17 67
RESIDUAL	3									85
NET CAPITAL	214									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	24	1	2	2	2	4	5	6	
SLUDGE (\$1000/YR)	1	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	1	1	1	1	1	1	1
TOTAL (\$1000/YR)	26	1	3	4	4	5	6	8	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	35	11	16	18	36	44	52	0	
PRESENT WORTH (\$1000)	35	9	9	7	10	6	4	0	
NET O.+M. =	84								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	214
O.+M. (\$1000)	84
LAND (\$1000)	8
TOTAL (\$1000)	306

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		1	1	1	1	1	1	1
SEWERS			24	24	24	24	24	24
TOTAL O.+M.	26	1	3	4	4	5	6	8
TOTAL ANNUAL	26	3	30	30	30	31	33	34

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED DEBT.

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS.

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B - TPOY TWP.

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	820	1035	1250	1465	1680	2230	2720	3140
FLOW (MGD)								
DOMESTIC	0.09	0.12	0.15	0.18	0.21	0.29	0.38	0.47
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.09	0.12	0.15	0.18	0.21	0.29	0.38	0.47
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	16		18					18		12
RESIDUAL	0									12
NET CAPITAL	15									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	13	1	1	1	2	2	3	4
SLUDGE	(\$1000/YR)	1	0	0	0	0	0	0	0
SEWEKS	(\$1000/YR)	0	0	0	0	0	0	0	0
<hr/>									
TOTAL	(\$1000/YR)	14	1	1	1	2	2	3	4
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		20	5	6	8	17	24	30	0
PRESENT WORTH (\$1000)		20	4	4	3	5	3	2	0
NET O.+M. =	44								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	15
O.+M. (\$1000)	
LAND (\$1000)	5
TOTAL (\$1000)	

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		1	1	1	1	1	1	1
TOTAL O.+M.	14	1	1	1	2	2	3	4
TOTAL ANNUAL	14	2	2	3	3	4	5	6

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B - MANTUA

	1972	1975	1980	1985	1990	2000	2010	2020
PUPULATION	1440	1645	1850	2115	2380	2940	3620	3975
FLUM (MGD)								
DOMESTIC	0.16	0.19	0.22	0.27	0.33	0.38	0.51	0.60
INDUSTRIAL	0.13	0.14	0.15	0.16	0.17	0.20	0.23	0.26
TOTAL	0.29	0.33	0.37	0.43	0.50	0.58	0.74	0.86
SLUDGE (TPU)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	22		25					25		17
RESIDUAL	0									
NET CAPITAL	21									17
									TOTAL	17

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	42	2	2	3	3	4	5	6
SLUDGE	(\$1000/YR)	3	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>45</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		61	10	12	14	29	35	43	0
PRESENT WORTH (\$1000)									
		61	8	7	6	8	5	3	0
NET O.+M. =									
	101								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	21
O.+M. (\$1000)	101
LAND (\$1000)	0
TOTAL (\$1000)	122

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		1	1	1	1	1	1	1
TOTAL O.+M.	45	2	2	3	3	4	5	6
TOTAL ANNUAL	45	4	4	5	5	6	7	8

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INTERESTMENTS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - RANDOLPH TWP.

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1820	2160	2500	2850	3200	3840	4650	5000
FLOW (MGD)								
DOMESTIC	0.20	0.25	0.30	0.35	0.40	0.50	0.65	0.75
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.20	0.25	0.30	0.35	0.40	0.50	0.65	0.75
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	20		23					23		16
SEWERS	172		211							21
RESIDUAL	1									
NET CAPITAL	191									37
								TOTAL		

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	29	2	2	2	3	4	5	6
SLUDGE	(\$1000/YR)	3	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	1	1	1	1	1	1	1
TOTAL	(\$1000/YR)	32	3	3	3	4	5	6	7
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		46	13	15	16	32	39	46	0
PRESENT WORTH (\$1000)		46	10	8	6	9	5	3	0
NET O.+M. =	91								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	191
O.+M. (\$1000)	91
LAND (\$1000)	8
TOTAL (\$1000)	290

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		1	1	1	1	1	1	1
SEWERS		15	15	15	15	15	15	15
TOTAL O.+M.	32	3	3	3	4	5	6	7
TOTAL ANNUAL	32	20	20	20	21	22	23	24

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN 3 - UPPER EAST BRANCH

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	727	1863	3000	4220	5440	6230	6860	7333
FLUW (MGD)								
DOMESTIC	0.08	0.22	0.36	0.52	0.68	0.81	0.96	1.11
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.08	0.22	0.36	0.52	0.68	0.81	0.96	1.11
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	23		26					26		18
RESIDUAL	0									18
NET CAPITAL	22									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	1	2	3	4	5	7	8
SLUDGE	(\$1000/YR)	0	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	1	2	3	4	5	7	8
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		2	8	13	17	38	45	53	0
PRESENT WORTH (\$1000)									
		2	7	7	7	11	6	4	0
NET O.+M. = 47.2511									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	22
O.+M. (\$1000)	47
LAND (\$1000)	0
TOTAL (\$1000)	69

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		2	2	2	2	2	2	2
TOTAL O.+M.	0	1	2	3	4	5	7	8
TOTAL ANNUAL	0	3	4	5	6	7	9	10

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN B, HINCKLEY

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1090	2835	4580	6450	8320	9600	10700	11470
FLOW (MGD)								
DOMESTIC	0.12	0.33	0.55	0.79	1.04	1.25	1.50	1.72
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.12	0.33	0.55	0.79	1.04	1.25	1.50	1.72
SLUDGE (TPO) GENERATED DISCHARGED	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	32		36					36		25
SEWERS	2309		2830							283
RESIDUAL	11									
NET CAPITAL	2330									308

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	1	2	3	4	5	7	8	
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	14	14	14	14	14	14	14	14
TOTAL (\$1000/YR)	0	15	16	17	19	20	21	22	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	21	66	71	75	137	145	153	0	
PRESENT WORTH (\$1000)	21	54	41	31	40	21	11	0	
NET O.+M. =	222.852								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2330
O.+M. (\$1000)	222
LAND (\$1000)	0
TOTAL (\$1000)	2552

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		2	2	2	2	2	2	2
SEWERS		204	204	204	204	204	204	204
TOTAL O.+M.	0	15	16	17	19	20	21	22
TOTAL ANNUAL	0	223	224	225	226	227	228	229

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN 6 - MALLEY CREEK

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	900	1285	1670	2035	2400	3080	3570	4000
FLOW (MGD)								
DOMESTIC	0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.60
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.60
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	17		20					20		14
SEWERS	148		182							18
RESIDUAL	1									
NET CAPITAL	165									32
									TOTAL	

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	12	1	2	2	3	4	5	6
SLUDGE	(\$1000/YR)	1	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	13	2	2	3	3	4	6	7
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		19	11	13	15	31	38	45	0
PRESENT WORTH (\$1000)		19	9	7	6	9	5	3	0
NET O.+M. =	61								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	165
O.+M. (\$1000)	61
LAND (\$1000)	0
TOTAL (\$1000)	226

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		1	1	1	1	1	1	1
SEWERS		13	13	13	13	13	13	13
TOTAL O.+M.	13	2	2	3	3	4	6	7
TOTAL ANNUAL	13	17	17	18	18	19	20	21

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B, RAVENNA

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	13445	17804	22324	29742	37160	53650	66220	74315
FLOW (MGD)								
DOMESTIC	1.43	2.03	2.63	3.66	4.64	7.62	9.55	11.15
INDUSTRIAL	0.57	0.62	0.67	0.72	0.77	0.91	1.05	1.19
TOTAL	2.05	2.70	3.35	4.33	5.41	8.53	10.60	12.34
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT SEWERS	111 1204		125 1476					125		89 147
RESIDUAL	9									
NET CAPITAL	1307									TOTAL 236

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	202	5	6	3	10	17	21	24
SLUDGE	(\$1000/YR)	8	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	7	7	7	7	7	7	7
TOTAL	(\$1000/YR)	210	12	14	16	13	24	28	32
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		291	55	62	70	150	136	213	0
PRESENT WORTH (\$1000)		291	45	36	29	44	23	16	0
NET O.+M. =		490							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1307
O.+M. (\$1000)	490
LAND (\$1000)	0
TOTAL (\$1000)	1797

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL NEW PLANT SEWERS		106	106	106	106	106	106	106
TOTAL O.+M.	210	12	14	16	13	24	28	32
TOTAL ANNUAL	210	120	130	132	134	141	145	143

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B - MEDINA CO.

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	3727	7323	10920	13300	15680	19769	24357	33333
FLOW (MGD)								
DOMESTIC	0.41	0.86	1.31	1.64	1.96	2.57	3.41	5.00
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.41	0.86	1.31	1.64	1.96	2.57	3.41	5.00
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	62		70					70		49
SEWERS	1090		1336							133
RESIDUAL	7								TOTAL	183
NET CAPITAL	1145									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>
PLANT	(\$1000/YR)	48	2	3	4	5	7	9	13
SLUDGE	(\$1000/YR)	5	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	6	6	6	6	6	6	6
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>53</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>16</u>	<u>20</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		81	39	43	47	90	104	127	0
PRESENT WORTH (\$1000)		81	32	25	19	26	15	9	0
NET C.+M. =	211								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1145
O.+M. (\$1000)	211
LAND (\$1000)	0
TOTAL (\$1000)	1356

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		5	5	5	5	5	5	5
SEWERS		96	96	96	96	96	96	96
TOTAL O.+M.	53	9	10	11	12	13	16	20
TOTAL ANNUAL	53	111	112	113	114	115	118	122

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BOND OR INDEBTEDNESS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B, NEW MEDINA

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	5545	10939	16333	19886	23440	29540	36500	49666
FLOW (MGD)								
DOMESTIC	1.38	2.14	2.91	3.48	4.05	5.28	6.82	7.48
INDUSTRIAL	0.78	0.87	0.96	1.04	1.13	1.42	1.71	2.01
TOTAL	2.16	3.01	3.87	4.52	5.18	6.70	8.53	9.49
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	93		105					105		74
SEWERS	1167		1430							143
RESIDUAL	8									
NET CAPITAL	1252									217

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	161	6	8	9	11	14	18	20
SLUDGE	(\$1000/YR)	0	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	7	7	7	7	7	7	7
TOTAL	(\$1000/YR)	161	13	15	17	18	21	25	27
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		249	60	67	72	141	167	188	0
PRESENT WORTH (\$1000)		249	49	38	30	41	25	14	0
NET O.+M. =		446							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1252
O.+M. (\$1000)	446
LAND (\$1000)	0
TOTAL (\$1000)	1698

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
NEW PLANT		8	8	8	8	8	8	8
SEWERS		103	103	103	103	103	103	103
TOTAL O.+M.	179	13	15	17	18	21	25	27
TOTAL ANNUAL	179	125	127	128	130	133	137	139

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLANT B, SHALERSBORO

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	5360	6260	7000	7500	8360	10220	12360	13333
FLOW (MGD)								
DOMESTIC	0.55	1.71	0.34	0.90	1.12	1.42	1.73	2.00
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.55	0.71	0.34	0.90	1.12	1.42	1.73	2.00
SLUDGE (TPD)								
GENERATED	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT SEWERS	35 323		40	556				40		28 111
RESIDUAL	5									
NET CAPITAL	353									TOTAL 139

TABLE II : PRESENT WORTH - O. &amp; M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	2	3	3	4	4	6	7	8
SLUDGE	(\$1000/YR)	0	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	2	2	2	2	2	2
TOTAL	(\$1000/YR)	2	3	6	7	7	8	10	11
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		7	10	27	30	33	67	76	80
PRESENT WORTH (\$1000)		7	16	16	12	17	10	5	0
NET O.&M. =	85.6765								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	353
O. & M. (\$1000)	85
LAND (\$1000)	33
TOTAL (\$1000)	472

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL NEW PLANT SEWERS		3	3	3	3	3	3	3
TOTAL O. & M.	2	3	6	7	7	8	10	11
TOTAL ANNUAL	2	6	9	10	10	11	13	14

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN B - CHARDON

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	1800	2980	4160	6080	8000	10000	12100	13300
FLOW (MGD)								
DOMESTIC	0.02	0.03	0.05	0.07	0.10	0.13	0.17	0.20
INDUSTRIAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.02	0.03	0.05	0.07	0.10	0.13	0.17	0.20
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXISTING PLANT	6			10					10	8
RESIDUAL	0								TOTAL	8
NET CAPITAL	6									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	0	1	1
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	0	1	1
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	1	1	2	5	7	9	0	0
PRESENT WORTH (\$1000)	0	0	1	1	1	1	0	0	0
NET O.+M.	6.7929								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	6
O.+M. (\$1000)	6
LAND (\$1000)	0
TOTAL (\$1000)	12

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXISTING PLANT			0	0	0	0	0	0
TOTAL O.+M.	0	0	0	0	0	0	1	1
TOTAL ANNUAL	0	0	1	1	1	1	2	2

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B, CH-7

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	1	2	3	3	3
ANNUAL RUNOFF	0	0	0	15	30	45	61	61
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	56	84	114	114
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	81					275				38
BASIN	39					135				53
PIPES	59					200				79
RESIDUAL	6									
NET CAPITAL	173									TOTAL 172

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	0	0	0	0	1	1	2	2
SLUDGE	(\$1000/YR)	0	0	0	0	1	2	2	2
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
<hr/>									
TOTAL	(\$1000/YR)	0	0	0	0	3	4	5	5
<hr/>									
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	28	37	42	0
<hr/>									
PRESENT WORTH (\$1000)		0	0	0	0	8	5	3	0
<hr/>									
NET O.+M. =		17.313							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	173
O.+M. (\$1000)	17
LAND (\$1000)	4
TOTAL (\$1000)	195

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					21	21	21	21
BASIN					9	9	9	9
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	3	4	5	5
TOTAL ANNUAL	0	0	0	0	43	50	51	51

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

### PLAN B - CIP-11

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR. STORM RUNOFF	0	0	0	1	2	2	4	4
ANNUAL RUNOFF	0	0	0	24	46	48	73	73
SLUDGE QUANTITIES (CY/YR)								
SEDIMENTATION	0	0	0	0	90	90	136	136
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	89					300				41
BASIN	43					147				58
PIPES	702					2647				1058
RESIDUAL	44									
NET CAPITAL	370									
									TOTAL	1159

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	1	1	2	2
SLUDGE	(\$1000/YR)	0	0	0	0	2	2	3	3
SEWERS	(\$1000/YR)	0	0	0	0	13	13	13	13
TOTAL	(\$1000/YR)	0	0	0	0	17	17	19	19
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	120	127	134	0
PRESENT WORTH (\$1000)		0	0	0	0	35	19	10	0
NET O.+M. =	65.1832								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	870
O.+M. (\$1000)	65
LAND (\$1000)	1
TOTAL (\$1000)	936

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					23	23	23	23
BASIN					10	10	10	10
PIPES					191	191	191	191
TOTAL O.+M.	0	0	0	0	17	17	19	19
TOTAL ANNUAL	0	0	0	0	242	242	244	244

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BOND INTERESTNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT HAS BEEN USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN NO. CH-12413

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	3	7	14	20	23
ANNUAL RUNOFF	0	0	0	53	106	209	286	332
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	198	391	536	622
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	212					720				100
BASIN	103					350				139
PIPES	443					1500				599
PIPES	225						1500			900
RESIDUAL	67									
NET CAPITAL	918									TOTAL 1740

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		---	---	---	---	---	---	---	---
PLANT	(\$1000/YR)	0	0	0	0	3	7	10	11
SLUDGE	(\$1000/YR)	0	0	0	0	4	9	13	15
SEWERS	(\$1000/YR)	0	0	0	0	7	14	14	14
		---	---	---	---	---	---	---	---
TOTAL	(\$1000/YR)	0	0	0	0	16	32	38	42
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	169	247	283	0
PRESENT WORTH (\$1000)		0	0	0	0	50	37	21	0
NET O.+M. =		109.038							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	918
O.+M. (\$1000)	109
LAND (\$1000)	5
TOTAL (\$1000)	1032

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					55	55	55	55
BASIN					25	25	25	25
PIPES					108	108	108	108
PIPES						108	108	108
TOTAL O.+M.	0	0	0	0	16	32	38	42
TOTAL ANNUAL	0	0	0	0	205	330	336	340

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN NO. CH-16-17-18

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	4	8	10	13	15
ANNUAL RUNOFF	0	0	0	70	141	181	226	269
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	205	264	329	392
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	85					290				115
PIPES	1127					3813				1525
RESIDUAL	63									
NET CAPITAL	1149									TOTAL 1641

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
PLANT	(\$1000/YR)	0	0	0	0	5	7	9	11
SLUDGE	(\$1000/YR)	0	0	0	0	5	6	8	9
SEWERS	(\$1000/YR)	0	0	0	0	19	19	17	19
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>30</u>	<u>33</u>	<u>36</u>	<u>40</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	222	246	270	0
PRESENT WORTH	(\$1000)	0	0	0	0	65	37	20	0
NET O.+M. =		123.535							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1149
O.+M. (\$1000)	123
LAND (\$1000)	11

TOTAL (\$1000) 1284

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					20	20	20	20
PIPES					276	276	276	276
TOTAL O.+M.	0	0	0	0	30	33	36	40
TOTAL ANNUAL	0	0	0	0	327	330	333	337

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# SEWAGE TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN II - CH-19

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	1	2	2	3
ANNUAL RUNOFF	0	0	0	7	15	31	37	46
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	28	54	69	86
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	81					275				38
SEDIMENT BASIN	35					120				47
PIPES	59					200				79
RESIDUAL	6									
NET CAPITAL	169									169

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	1	1	1
SEDIMENT BASIN (\$1000/YR)	0	0	0	0	0	0	1	1	2
PIPES (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	2	3	4	4
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	20	26	30	0	0
PRESENT WORTH (\$1000)	0	0	0	0	5	3	2	0	0
NET O.+M. =	12.3456								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	169
O.+M. (\$1000)	12
LAND (\$1000)	1
TOTAL (\$1000)	182

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
INITIAL CAPITAL								
TREATMENT PLANT					21	21	21	21
SEDIMENT BASIN					0	8	8	8
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	2	3	4	4
TOTAL ANNUAL	0	0	0	0	4.5	4.7	4.8	4.9

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING UNPAID INTERESTS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN H - CH-20

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	2	2	3
ANNUAL RUNOFF	0	0	0	0	0	30	36	45
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	56	67	84
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	41						275			117
BASIN	18						120			72
PIPES	30						200			120
RESIDUAL	12									
NET CAPITAL	77									
									TOTAL	309

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	1	1	1
SLUDGE (\$1000/YR)	0	0	0	0	0	0	1	1	2
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	3	3	4
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	26	30	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	3	2	0
NET O.+M. =	6.22632								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	77
O.+M. (\$1000)	6
LAND (\$1000)	1
TOTAL (\$1000)	84

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						21	21	21
BASIN						8	8	8
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	3	3	4
TOTAL ANNUAL	0	0	0	0	0	47	43	49

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## GRUPP ENGINEERS - SURVEY SCOPE STUDY

PLAN 3, CM-21022

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	3	3	4
ANNUAL RUNOFF	0	0	0	0	0	53	63	79
SLUDGE QUANTITIES (GT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	99	118	148
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	46						310			132
BASIN	21						140			84
PIPES	180						1200			720
RESIDUAL	36									
NET CAPITAL	211								TOTAL	936

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	1	2	2
SLUDGE (\$1000/YR)	0	0	0	0	0	0	2	2	3
SEWER (\$1000/YR)	0	0	0	0	0	0	5	5	5
TOTAL (\$1000/YR)	0	0	0	0	0	0	10	11	12
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	75	82	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	11	6	0
NET O.+M. =	17.6931								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	211
O.+M. (\$1000)	17
LAND (\$1000)	1
TOTAL (\$1000)	230

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						23	23	23
BASIN						10	10	10
PIPES						86	86	86
TOTAL O.+M.	0	0	0	0	0	10	11	12
TOTAL ANNUAL	0	0	0	0	0	131	132	133

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN R. CH-23-26-27

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	4	7	10	21	31	39
ANNUAL RUNOFF	0	29	58	114	170	341	468	595
SLUDGE QUANTITIES (0T/YR)								
SEDIMENT-BASIN	0	42	84	166	248	497	683	868
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDU
BASIN	145			250						49
BASIN	109					370				147
BASIN	40						270			162
PIPES	1571			2700						539
PIPES	976					3300				1319
PIPES	75						500			300
RESIDUAL	97									
NET CAPITAL	2320									TOTAL 2519

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
PLANT	(\$1000/YR)	0	0	2	4	6	13	18	23
SLUDGE	(\$1000/YR)	0	0	2	4	6	12	17	21
SEWERS	(\$1000/YR)	0	0	13	13	29	32	32	32
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>17</u>	<u>22</u>	<u>42</u>	<u>58</u>	<u>67</u>	<u>77</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	81	133	354	442	510	0
PRESENT WORTH	(\$1000)	0	0	47	55	104	66	38	0
NET O.+M. =		313.509							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2820
O.+M. (\$1000)	313
LAND (\$1000)	32
TOTAL (\$1000)	3164

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			18	19	18	18	18	18
BASIN					26	26	26	26
BASIN						19	19	19
PIPES			195	195	195	195	195	195
PIPES					238	238	238	238
PIPES						36	36	36
TOTAL O.+M.	0	0	17	22	42	58	67	77
TOTAL ANNUAL	0	0	231	235	522	593	602	612

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B . CH-24

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	9	12
ANNUAL RUNOFF	0	0	0	0	0	121	146	182
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	226	273	341
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME - STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	79						530			227
BASIN	37						250			150
PIPES	30						200			120
RESIDUAL	19									
NET CAPITAL	128									497

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
LANT (\$1000/YR)	0	0	0	0	0	0	4	5	6
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	6	8
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	10	12	15
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	83	101	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	12	7	0
ET O.+M. =	20.3441								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	128
O.+M. (\$1000)	20
LAND (\$1000)	3
TOTAL (\$1000)	151

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						40	40	40
BASIN						18	18	18
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	10	12	15
TOTAL ANNUAL	0	0	0	0	0	64	66	69

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B . CH-25

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	7	8	11
ANNUAL RUNOFF	0	0	0	0	0	105	126	158
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	196	236	296
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	79						530			227
BASIN	37						250			150
PIPES	30						200			120
RESIDUAL	19									
NET CAPITAL	128									TOTAL 497

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	4	5
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	5	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	9	11	13
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	73	88	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	11	6	0
NET O.+M. =	17.8208								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	128
O.+M. (\$1000)	17
LAND (\$1000)	3
TOTAL (\$1000)	148

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						40	40	40
BASIN						18	18	18
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	9	11	13
TOTAL ANNUAL	0	0	0	0	0	63	84	87

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BUYED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## COMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN 8 - CM-28

	1972	1975	1980	1985	1990	2000	2010	2020
TORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	8	6	8	10
ANNUAL RUNOFF	0	0	0	0	0	95	113	141
LUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	178	211	264
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

LUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	73						490			210
BASIN	33						225			135
PIPES	45						300			180
RESIDUAL	20								TOTAL	525
NET CAPITAL	132									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
LAND (\$1000/YR)	0	0	0	0	0	0	3	3	4
LUDGE (\$1000/YR)	0	0	0	0	0	0	4	5	6
SEWERS (\$1000/YR)	0	0	0	0	0	0	1	1	1
TOTAL (\$1000/YR)	0	0	0	0	0	0	9	10	13
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	70	83	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	10	6	0
ET O.+M. =	16.9636								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	132
O.+M. (\$1000)	16
LAND (\$1000)	2
TOTAL (\$1000)	151

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						37	37	37
BASIN						16	16	16
PIPES						21	21	21
TOTAL O.+M.	0	0	0	0	0	9	10	13
TOTAL ANNUAL	0	0	0	0	0	85	86	88

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B. CH-29

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	1	3
ANNUAL RUNOFF	0	0	0	0	0	28	34	43
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	52	63	80
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	41						275			117
BASIN	15						100			60
PIPES	30						200			120
TREATMENT PLANT	0							0		0
RESIDUAL	11									
NET CAPITAL	74									297

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	0	0	1	1
SLUDGE	(\$1000/YR)	0	0	0	0	0	1	1	2
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	0	3	3	4
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	0	24	29	0
PRESENT WORTH (\$1000)		0	0	0	0	0	3	2	0
NET O.+M. =	5.96548								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	74
O.+M. (\$1000)	5
LAND (\$1000)	1
TOTAL (\$1000)	81

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						21	21	21
BASIN						7	7	7
PIPES						14	14	14
TREATMENT PLANT						0	0	0
TOTAL O.+M.	0	0	0	0	0	3	3	4
TOTAL ANNUAL	0	0	0	0	0	46	46	47

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CUPPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B . CM-30632N

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	1	11	11	11
ANNUAL RUNOFF	0	0	0	6	12	150	164	174
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	17	230	239	254
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

ORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
IN	70					240				95
PIPES	369					1250				499
PIPES	165						1100			660
RESIDUAL	48									
NET CAPITAL	557								TOTAL	1255

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	6	7	7
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	5	6
PIPPERS (\$1000/YR)	0	0	0	0	0	6	11	11	11
TAL (\$1000/YR)	0	0	0	0	0	7	24	24	25
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	110	172	176	0
PRESENT WORTH (\$1000)	0	0	0	0	0	32	25	13	0
NET O.+M. =	72.1838								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	557
O.+M. (\$1000)	72
LAND (\$1000)	3

TOTAL (\$1000) 632

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					17	17	17	17
PIPES					90	90	90	90
PIPES						79	79	79
TOTAL O.+M.	0	0	0	0	7	24	24	25
TAL ANNUAL	0	0	0	0	115	211	212	213

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, CH-31

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	4	6	7
ANNUAL RUNOFF	0	0	0	0	0	68	83	103
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	127	155	193
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	60						400			171
BASIN	26						175			105
PIPES	30						200			120
RESIDUAL	15									
NET CAPITAL	101									396

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	2	2	3
SLUDGE (\$1000/YR)	0	0	0	0	0	0	3	3	4
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	6	7	9
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	50	60	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	7	4	0
NET O.+M. =	12.2086								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	101
O.+M. (\$1000)	12
LAND (\$1000)	2
TOTAL (\$1000)	115

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						30	30	30
BASIN						12	12	12
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	6	7	9
TOTAL ANNUAL	0	0	0	0	0	64	65	67

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN R - CH-325633

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR. STORM RUNOFF	0	0	0	0	1	13	14	14
ANNUAL RUNOFF	0	0	0	13	26	183	194	205
SLUDGE QUANTITIES (D1/YR)								
SEDIMENT-BASIN	0	0	0	0	48	343	363	384
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	168					570				79
BASIN	73					250				99
PIPES	331					1120				447
PIPES	30						200			120
RESIDUAL	29									
NET CAPITAL	574									
									TOTAL	747

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	0	6	6	7
SLUDGE	(\$1000/YR)	0	0	0	0	1	8	9	9
SEWERS	(\$1000/YR)	0	0	0	0	5	6	6	6
TOTAL	(\$1000/YR)	0	0	0	0	7	21	22	23
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	102	154	161	0
PRESENT WORTH (\$1000)		0	0	0	0	30	23	12	0
NET O.+M. =	66.0294								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	574
O.+M. (\$1000)	66
LAND (\$1000)	2
TOTAL (\$1000)	642

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					44	44	44	44
BASIN					19	18	18	18
PIPES					81	81	81	81
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	7	21	22	23
TOTAL ANNUAL	0	0	0	0	150	179	180	181

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - CH-34

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	2	3
ANNUAL RUNOFF	0	0	0	0	0	34	40	51
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	63	75	95
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	41						275			117
BASIN	18						120			72
PIPES	30						200			120
RESIDUAL	12									
NET CAPITAL	77									309

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	1	1	1
SLUDGE (\$1000/YR)	0	0	0	0	0	0	1	1	2
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	3	4	5
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	28	33	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	4	2	0
NET O.+M. =	6.79194								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	77
O.+M. (\$1000)	6
LAND (\$1000)	1
TOTAL (\$1000)	85

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						21	21	21
BASIN						8	8	8
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	3	4	5
TOTAL ANNUAL	0	0	0	0	0	48	48	49

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B . CH-35

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	4	5	6	9
ANNUAL RUNOFF	0	0	0	29	59	71	88	118
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	110	133	165	221
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	136					460				64
BASIN	54					185				73
PIPES	59					200				79
RESIDUAL	8									
NET CAPITAL	241									218

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	0	0	0	0	2	2	3	4
SLUDGE	(\$1000/YR)	0	0	0	0	2	3	4	5
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	5	6	8	10
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	46	52	66	0
PRESENT WORTH (\$1000)		0	0	0	0	13	7	5	0
NET O.+M. =	26.1279								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	241
O.+M. (\$1000)	26
LAND (\$1000)	2
TOTAL (\$1000)	269

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					35	35	35	35
BASIN					13	13	13	13
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	5	6	8	10
TOTAL ANNUAL	0	0	0	0	69	70	71	74

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - CH-36

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	9	11
ANNUAL RUNOFF	0	0	0	0	0	111	133	166
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	208	249	311
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	76						510			218
BASIN	33						220			132
PIPES	105						700			420
RESIDUAL	29									
NET CAPITAL	185									
									TOTAL	770

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	4	5
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	6	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	3	3	3
TOTAL (\$1000/YR)	0	0	0	0	0	0	12	14	17
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	94	110	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	14	8	0
NET O.+M. =	22.6948								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	185
O.+M. (\$1000)	22
LAND (\$1000)	3
TOTAL (\$1000)	210

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						39	39	39
BASIN						15	15	15
PIPES						50	50	50
TOTAL O.+M.	0	0	0	0	0	12	14	17
TOTAL ANNUAL	0	0	0	0	0	118	120	123

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## COMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, R-85 11

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	3	6	12	18	61	62	62
ANNUAL RUNOFF	0	32	65	152	240	845	845	861
SLUDGE QUANTITIES (OT/YR)								
SEDIMENT BASIN	0	60	121	285	600	2112	2112	2152
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	490			770					770	659
PLANT EXPANSION	1541					5210				729
BASIN	93			160						31
BASIN	63					216				86
PIPES	650					2200				879
RESIDUAL	92								TOTAL	2387
NET CAPITAL	2746									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	2	21	60	211	211	215
SLUDGE	(\$1000/YR)	0	0	3	7	15	52	52	53
SEWERS	(\$1000/YR)	0	0	0	0	10	10	10	10
TOTAL	(\$1000/YR)	0	0	5	28	85	275	275	280
PRIENT VALUE AT BEGINNING OF PERIOD (\$1000)		0	0	70	235	1267	1931	1949	0
PRESENT WORTH (\$1000)		0	0	40	97	375	290	148	0
NET O.+M. =									953.078

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2746
O.+M. (\$1000)	953
LAND (\$1000)	15
TOTAL (\$1000)	3714

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			59	59	59	59	59	59
PLANT EXPANSION					402	402	402	402
BASIN			11	11	11	11	11	11
BASIN					15	15	15	15
PIPES					159	159	159	159
TOTAL O.+M.	0	0	5	28	85	275	275	280
TOTAL ANNUAL	0	0	76	99	734	923	923	928

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, R-9

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	2	2	2	2	2	2	2	2
ANNUAL RUNOFF	38	39	41	41	41	41	41	41
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	22	23	23	23	23	23	23	23
TREATMENT PLANT	8	9	9	9	9	9	9	9

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
SLUDGE HANDLING	8		10					10		7
BASIN	465		570							57
PIPES	163		200							20
RESIDUAL	3									
NET CAPITAL	634									TOTAL 84

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	10	10	11	13	13	13	13	13
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	11	12	13	14	14	14	14	14
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	49	52	57	102	102	102	102	0
PRESENT WORTH (\$1000)	0	40	30	23	30	15	7	0	0
NET O.+M. =	148.564								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	634
O.+M. (\$1000)	148
LAND (\$1000)	11
TOTAL (\$1000)	793

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
SLUDGE HANDLING		0	0	0	0	0	0	0
BASIN		41	41	41	41	41	41	41
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	11	12	13	14	14	14	14
TOTAL ANNUAL	0	68	68	69	71	71	71	71

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, K-19

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	9	14	17
ANNUAL RUNOFF	0	0	0	0	0	139	209	251
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	260	391	470
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	91						610			261
BASIN	42						280			168
PIPES	30						200			120
RESIDUAL	21									
NET CAPITAL	142									
									TOTAL	549

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	4	7	8
SLUDGE (\$1000/YR)	0	0	0	0	0	0	6	9	11
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	12	18	21
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	107	139	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	16	10	0
NET O.+M. =	26.7464								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	142
O.+M. (\$1000)	26
LAND (\$1000)	30
TOTAL (\$1000)	199

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						47	47	47
BASIN						20	20	20
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	12	18	21
TOTAL ANNUAL	0	0	0	0	0	94	99	103

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN 8, R-20

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	6	12	14	19	25
ANNUAL RUNOFF	0	0	0	92	184	220	275	368
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	345	412	515	690
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	176					595				83
BASIN	100					340				135
PIPES	1156					3909				1563
RESIDUAL	69									
NET CAPITAL	1363									TOTAL 1782

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>-----</u>	<u>-----</u>	<u>-----</u>	<u>-----</u>	<u>-----</u>	<u>-----</u>	<u>-----</u>	<u>-----</u>
PLANT	(\$1000/YR)	0	0	0	0	6	7	9	12
SLUDGE	(\$1000/YR)	0	0	0	0	8	10	12	17
SEWERS	(\$1000/YR)	0	0	0	0	19	19	19	19
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>34</u>	<u>37</u>	<u>42</u>	<u>49</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	253	279	322	0
PRESENT WORTH (\$1000)		0	0	0	0	74	42	24	0
NET O.+M. =		141.63							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1363
O.+M. (\$1000)	141
LAND (\$1000)	6
TOTAL (\$1000)	1511

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					45	45	45	45
BASIN					24	24	24	24
PIPES					283	283	283	283
TOTAL O.+M.	0	0	0	0	34	37	42	49
TOTAL ANNUAL	0	0	0	0	388	391	395	403

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

PLAN ...

	1972	1975	1980	1985	1990	2000	2010	2020
STORAGE BASIN VOLUME (MG)								
1 YEAR SCOUR RUMPLE	0	0	0	7	15	28	35	42
ANNUAL SCOUR	0	0	0	113	227	426	512	665
SLUDGE QUANTITIES (CY/YR)								
SEDIMENT BASIN	0	0	0	0	331	621	747	970
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	133					450				179
PIPES	158					535				213
PIPES	75						500			300
RESIDUAL	26									TOTAL 693
NET CAPITAL	339									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	8	16	19	25
STORAGE (\$1000/YR)	0	0	0	0	0	8	15	18	24
STREETS (\$1000/YR)	0	0	0	0	0	2	5	5	5
TOTAL (\$1000/YR)	0	0	0	0	0	19	36	43	54
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	193	281	344	0
PRESENT WORTH (\$1000)	0	0	0	0	0	58	42	26	0
NET O.+M.	127.367								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	339
O.+M. (\$1000)	127
LAND (\$1000)	10
TOTAL (\$1000)	477

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					32	32	32	32
PIPES					38	38	38	38
PIPES					36	36	36	36
TOTAL O.+M.	0	0	0	0	19	36	43	54
TOTAL ANNUAL	0	0	0	0	50	144	150	167

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED DEBT OF \$5  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, R-24

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	4	9	14	19	23
ANNUAL RUNOFF	0	0	0	68	137	206	275	345
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	256	386	515	646
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	218					740				103
BASIN	106					360				143
PIPES	59					200				79
RESIDUAL	12									
NET CAPITAL	371									327

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	4	7	9	12
SLUDGE (\$1000/YR)	0	0	0	0	0	6	9	12	16
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	12	17	23	29
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	105	145	185	0
PRESENT WORTH (\$1000)	0	0	0	0	0	31	21	14	0
NET O.+M. =	67.2621								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	371
O.+M. (\$1000)	67
LAND (\$1000)	5
TOTAL (\$1000)	444

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					57	57	57	57
BASIN					26	26	26	26
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	12	17	23	29
TOTAL ANNUAL	0	0	0	0	109	115	121	126

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - R-255626

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	7	10
ANNUAL RUNOFF	0	0	0	0	0	88	123	150
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	165	230	281
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	72						480			205
BASIN	29						195			117
PIPES	300						2000			1200
RESIDUAL	59									
NET CAPITAL	343								TOTAL	1522

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	4	5
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	5	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	9	9	9
TOTAL (\$1000/YR)	0	0	0	0	0	0	17	20	22
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	130	148	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	19	11	0
NET O.+M. =	\$1.0506								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	343
O.+M. (\$1000)	31
LAND (\$1000)	2
TOTAL (\$1000)	376

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						37	37	37
BASIN						14	14	14
PIPES						144	144	144
TOTAL O.+M.	0	0	0	0	0	17	20	22
TOTAL ANNUAL	0	0	0	0	0	213	216	218

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, 3-27

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	3	7	11	13	14
ANNUAL RUNOFF	0	0	0	54	109	164	203	217
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	204	307	380	406
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	171					580				81
BASIN	76					260				103
PIPES	88					300				119
RESIDUAL	11									
NET CAPITAL	325									
									TOTAL	305

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	3	5	7	7	7
SLUDGE (\$1000/YR)	0	0	0	0	5	7	9	10	10
SEWERS (\$1000/YR)	0	0	0	0	1	1	1	1	1
TOTAL (\$1000/YR)	0	0	0	0	10	14	18	19	19
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	89	116	131	0	0
PRESENT WORTH (\$1000)	0	0	0	0	26	17	10	0	0
NET O.+M. =	53.8208								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	325
O.+M. (\$1000)	53
LAND (\$1000)	3
TOTAL (\$1000)	382

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					44	44	44	44
BASIN					18	18	18	18
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	10	14	18	19
TOTAL ANNUAL	0	0	0	0	95	100	103	104

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# ST INWATER TREATMENT PLANT

## COMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - K-28

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	37	49	62
ANNUAL RUNOFF	0	0	0	0	0	537	716	895
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	1006	1342	1678
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

ST AGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	340					1150				160
BASIN	159					540				215
PIPES	59					200				79
RESIDUAL	17									
NET CAPITAL	541									TOTAL 456

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	18	25	31
SLUDGE (\$1000/YR)	0	0	0	0	0	0	25	33	41
SEVICES (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOT (\$1000/YR)	0	0	0	0	0	0	44	59	74
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	161	367	470	0
PRESENT WORTH (\$1000)	0	0	0	0	0	47	55	35	0
NET O.+M. =	138.915								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	541
O.+M. (\$1000)	138
LAND (\$1000)	14
TOTAL (\$1000)	694

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					88	88	88	88
BASIN					39	39	39	39
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	0	44	59	74
TOT ANNUAL	0	0	0	0	143	187	201	216

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CUPPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN R, R-29

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	10	11
ANNUAL RUNOFF	0	0	0	0	0	112	135	168
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	210	253	315
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUA
TREATMENT PLANT	79						530			227
BASIN	36						240			144
PIPES	170						1136			681
RESIDUAL	40								TOTAL	1052
NET CAPITAL	245									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	0	3	4	5
SLUDGE	(\$1000/YR)	0	0	0	0	0	5	6	7
SEWERS	(\$1000/YR)	0	0	0	0	0	5	5	5
TOTAL	(\$1000/YR)	0	0	0	0	0	14	16	19
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	0	110	127	0
PRESENT WORTH (\$1000)		0	0	0	0	0	16	9	0
NET O.+M. =	26.385								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	245
O.+M. (\$1000)	26
LAND (\$1000)	3
TOTAL (\$1000)	275

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						40	40	40
BASIN						17	17	17
PIPES						82	82	82
TOTAL O.+M.	0	0	0	0	0	14	16	19
TOTAL ANNUAL	0	0	0	0	0	155	157	159

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - P-70633

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	8	9
ANNUAL RUNOFF	0	0	0	0	0	67	91	121
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	125	170	226
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	69						460			197
BASIN	30						205			123
PIPES	119						797			478
RESIDUAL	30									
NET CAPITAL	188								TOTAL	798

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	2	3	4
SLUDGE (\$1000/YR)	0	0	0	0	0	0	3	4	5
DEWEERS (\$1000/YR)	0	0	0	0	0	0	3	3	3
TOTAL (\$1000/YR)	0	0	0	0	0	0	9	11	13
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	73	88	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	11	6	0
NET O.+M. =	17.8373								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	188
O.+M. (\$1000)	17
LAND (\$1000)	2
TOTAL (\$1000)	208

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						35	35	35
BASIN						14	14	14
PIPES						57	57	57
TOTAL O.+M.	0	0	0	0	0	9	11	13
TOTAL ANNUAL	0	0	0	0	0	117	119	121

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, H-51

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	3	4
ANNUAL RUNOFF	0	0	0	0	0	34	51	70
SLUDGE QUANTITIES (WT/YR)								
SEDIMENT BASIN	0	0	0	0	0	63	95	131
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	43						290			124
BASIN	24						160			96
PIPES	30						200			120
RESIDUAL	13									
NET CAPITAL	84									TOTAL 340

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	1	1	2
SLUDGE (\$1000/YR)	0	0	0	0	0	0	1	2	3
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	3	5	6
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	31	41	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	4	3	0

NET O.+M. = 7.92663

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	84
O.+M. (\$1000)	?
LAND (\$1000)	1
TOTAL (\$1000)	93

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						22	22	22
BASIN						11	11	11
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	3	5	6
TOTAL ANNUAL	0	0	0	0	0	52	53	55

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# WORKS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN R. K-32

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	14	19	21
ANNUAL RUNOFF	0	0	0	0	0	206	274	302
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	386	513	566
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	105						700			300
BASIN	48						320			192
PIPES	285						1900			1140
RESIDUAL	63									
NET CAPITAL	375									
									TOTAL	1632

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	7	9	10
SLUDGE (\$1000/YR)	0	0	0	0	0	0	9	12	14
SEWERS (\$1000/YR)	0	0	0	0	0	0	9	9	9
TOTAL (\$1000/YR)	0	0	0	0	0	0	26	31	34
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	204	232	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	30	17	0
NET O.+M. =	48.5427								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	375
O.+M. (\$1000)	48
LAND (\$1000)	20
TOTAL (\$1000)	444

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						54	54	54
BASIN						23	23	23
PIPES						137	137	137
TOTAL O.+M.	0	0	0	0	0	26	31	34
TOTAL ANNUAL	0	0	0	0	0	241	246	248

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, R-34

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	4	5	7	9	11	11
ANNUAL RUNOFF	0	34	69	66	104	139	153	174
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	64	129	162	195	260	284	324
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	211				510					0
BASIN	101				245					73
PIPES	82				200					40
RESIDUAL	5									
NET CAPITAL	391									133

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
PLANT	(\$1000/YR)	0	0	0	3	3	4	5	6
SLUDGE	(\$1000/YR)	0	0	0	4	4	6	7	8
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>9</u>	<u>9</u>	<u>12</u>	<u>13</u>	<u>15</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	39	76	90	101	0
PRESENT WORTH	(\$1000)	0	0	0	16	22	13	7	0
NET O.+M. =		60.3341							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	391
O.+M. (\$1000)	60
LAND (\$1000)	17
TOTAL (\$1000)	468

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				39	39	39	39	39
BASIN				17	17	17	17	17
PIPES				14	14	14	14	14
TOTAL O.+M.	0	0	0	9	9	12	13	15
TOTAL ANNUAL	0	0	0	81	81	83	85	86

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN II, H-35

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	3	7	9	12	16	17	20
ANNUAL RUNOFF	0	60	120	150	180	240	264	300
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	112	225	281	337	450	495	562
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	432			680					680	582
BASIN	197			340						67
PIPES	116			200						39
RESIDUAL	26								TOTAL	690
NET CAPITAL	720									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>
PLANT	(\$1000/YR)	0	0	0	6	4	8	9	10
SLUDGE	(\$1000/YR)	0	0	0	8	8	11	12	14
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>15</u>	<u>15</u>	<u>20</u>	<u>22</u>	<u>25</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	34	64	127	151	169	0
PRESENT WORTH (\$1000)		0	0	19	26	37	22	12	0
NET O.+M. =		120.317							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	720
O.+M. (\$1000)	120
LAND (\$1000)	22

TOTAL (\$1000) 862

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			52	52	52	52	52	52
BASIN			24	24	24	24	24	24
PIPES			14	14	14	14	14	14
TOTAL O.+M.	0	0	0	15	15	20	22	25
TOTAL ANNUAL	0	0	92	107	107	112	114	117

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

**STORMWATER TREATMENT PLANT**
**CHAPS OF ENGINEERS - SURVEY SCOPE STUDY**
**PLAN B , CU-26**

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	1	3	4	5	6	8	8
ANNUAL RUNOFF	0	27	54	67	81	91	123	134
SLUDGE QUANTITIES (OT/YR)								
SEDIMENT BASIN	0	50	101	126	151	170	230	251
TREATMENT PLANT	0	0	0	0	0	0	0	0

**TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND**
**SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE**
**STORAGE BASIN : EARTH**
**TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)**

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	182				440					0
BASIN	91				220					66
PIPES	82				200					60
RESIDUAL	4									
NET CAPITAL	351									126

**TABLE II : PRESENT WORTH - O.+M. COSTS**

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>
PLANT	(\$1000/YR)	0	0	0	2	2	3	4	4
SLUDGE	(\$1000/YR)	0	0	0	3	3	4	5	6
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>7</u>	<u>7</u>	<u>8</u>	<u>11</u>	<u>11</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	31	56	68	80	0
PRESENT WORTH (\$1000)		0	0	0	12	16	10	6	0
NET O.+M. =	46.1814								

**TABLE III : TOTAL PRESENT WORTH**

CAPITAL (\$1000)	351
O.+M. (\$1000)	46
LAND (\$1000)	10
TOTAL (\$1000)	408

**TABLE IV : ANNUAL COSTS (\$1000/YR)**

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				33	33	33	33	33
BASIN				15	15	15	15	15
PIPES				14	14	14	14	14
TOTAL O.+M.	0	0	0	7	7	8	11	11
TOTAL ANNUAL	0	0	0	72	72	72	75	76

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN # . CU-27

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	4	9	10	12	17	22	22
ANNUAL RUNOFF	0	63	126	158	190	252	316	316
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	118	236	296	356	472	592	592
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	294				710					0
BASIN	149				360					108
PIPES	1680				4050					1215
RESIDUAL	51									
NET CAPITAL	2072									
									TOTAL	1323

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	6	6	8	11	11
SLUDGE	(\$1000/YR)	0	0	0	8	8	11	14	14
SEWERS	(\$1000/YR)	0	0	0	20	20	20	20	20
TOTAL	(\$1000/YR)	0	0	0	35	35	40	46	46
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		0	0	0	146	269	305	323	0
PRESENT WORTH (\$1000)		0	0	0	60	79	45	24	0
NET O.+M. =									211.276

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2072
O.+M. (\$1000)	211
LAND (\$1000)	24

TOTAL (\$1000) 2308

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				54	54	54	54	54
BASIN				26	26	26	26	26
PIPES				293	293	293	293	293
TOTAL O.+M.	0	0	0	35	35	40	46	46
TOTAL ANNUAL	0	0	0	409	409	414	420	420

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, CU-28

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	4	5	7	8
ANNUAL RUNOFF	0	0	0	36	72	86	108	121
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	135	161	202	226
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDU
TREATMENT PLANT	130					440				61
BASIN	62					210				81
PIPES	532					1890				714
RESIDUAL	33									
NET CAPITAL	691									861

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	2	3	3	4
SLUDGE	(\$1000/YR)	0	0	0	0	3	4	5	5
SEWERS	(\$1000/YR)	0	0	0	0	8	8	8	8
TOTAL	(\$1000/YR)	0	0	0	0	14	16	17	18
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	108	118	129	0
PRESENT WORTH (\$1000)		0	0	0	0	32	17	9	0
NET O.+M. =									59.8918

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	691
O.+M. (\$1000)	59
LAND (\$1000)	2
TOTAL (\$1000)	753

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					33	33	33	33
BASIN					15	15	15	15
PIPES					130	130	130	130
TOTAL O.+M.	0	0	0	0	14	16	17	18
TOTAL ANNUAL	0	0	0	0	194	195	197	198

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B. CU-29231

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	21	27	34
ANNUAL RUNOFF	0	0	0	0	0	329	395	495
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	616	740	928
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

-----SLUDGE HANDLING-----: PERIODIC REMOVAL TO LANDFILL OR RECYCLE-----

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	130						870			373
BASIN	61						410			246
PIPES	330						2200			1320
RESIDUAL	75									
NET CAPITAL	448									
									TOTAL	1939

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	0	11	13	17
SLUDGE	(\$1000/YR)	0	0	0	0	0	15	18	23
SEWERS	(\$1000/YR)	0	0	0	0	0	10	10	10
TOTAL	(\$1000/YR)	0	0	0	0	0	37	43	51
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	0	285	333	0
PRESENT WORTH (\$1000)		0	0	0	0	0	42	25	0
NET O.+M. =									68.3811

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	448
O.+M. (\$1000)	68
LAND (\$1000)	8
TOTAL (\$1000)	524

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						67	67	67
BASIN						29	29	29
PIPES						159	159	159
TOTAL O.+M.	0	0	0	0	0	37	43	51
TOTAL ANNUAL	0	0	0	0	0	294	299	307

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B . CU-30

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	6	8
ANNUAL RUNOFF	0	0	0	0	0	86	103	129
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	161	193	241
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	69						460			197
BASIN	33						220			132
PIPES	582						3870			2322
RESIDUAL	102									
NET CAPITAL	581									TOTAL 2651

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	3	4
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	4	6
SEWERS (\$1000/YR)	0	0	0	0	0	0	19	19	19
TOTAL (\$1000/YR)	0	0	0	0	0	0	26	27	29
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	190	202	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	28	15	0
NET O.+M. =	44.0925								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	581
O.+M. (\$1000)	44
LAND (\$1000)	2
TOTAL (\$1000)	627

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						35	35	35
BASIN						15	15	15
PIPES						280	280	280
TOTAL O.+M.	0	0	0	0	0	26	27	29
TOTAL ANNUAL	0	0	0	0	0	358	359	361

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

COMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - CU-34C-40-41

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	7	11
ANNUAL RUNOFF	0	0	0	0	0	93	111	138
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	174	208	258
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	76						510			218
BASIN	33						225			135
PIPES	451						3000			1800
RESIDUAL	83								TOTAL	2153
NET CAPITAL	478									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	3	4
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	5	6
SEWERS (\$1000/YR)	0	0	0	0	0	0	14	14	14
TOTAL (\$1000/YR)	0	0	0	0	0	0	22	24	26
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	164	176	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	24	13	0
NET O.+M. =	38.1854								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	478
O.+M. (\$1000)	38
LAND (\$1000)	2
TOTAL (\$1000)	518

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						39	39	39
BASIN						16	16	16
PIPES						217	217	217
TOTAL O.+M.	0	0	0	0	0	22	24	26
TOTAL ANNUAL	0	0	0	0	0	245	296	299

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN H, CU-36

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	10	13
ANNUAL RUNOFF	0	0	0	0	0	139	167	209
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	260	313	391
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	82						550			235
BASIN	40						270			162
PIPES	1114						7410			4446
RESIDUAL	187									
NET CAPITAL	1049									
									TOTAL	4843

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	4	5	7
SLUDGE (\$1000/YR)	0	0	0	0	0	0	6	7	9
SEWERS (\$1000/YR)	0	0	0	0	0	0	37	37	37
TOTAL (\$1000/YR)	0	0	0	0	0	0	48	50	54
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	348	368	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	52	28	0
NET O.+M. =	80.5101								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1049
O.+M. (\$1000)	80
LAND (\$1000)	3
TOTAL (\$1000)	1133

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						42	42	42
BASIN						19	19	19
PIPES						536	536	536
TOTAL O.+M.	0	0	0	0	0	48	50	54
TOTAL ANNUAL	0	0	0	0	0	646	649	652

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, CU-37

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	9	11	14
ANNUAL RUNOFF	0	0	0	0	0	133	159	199
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	249	298	373
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	87						580			248
BASIN	43						290			174
PIPES	30						200			120
RESIDUAL	21									
NET CAPITAL	139									542

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	3	4
SLUDGE (\$1000/YR)	0	0	0	0	0	0	8	10	13
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	0	0	0	0	0	13	15	19
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	99	120	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	15	9	0
NET O.+M. =	24.2741								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	139
O.+M. (\$1000)	24
LAND (\$1000)	3
TOTAL (\$1000)	167

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						44	44	44
BASIN						20	20	20
PIPES						14	14	14
TOTAL O.+M.	0	0	0	0	0	13	15	19
TOTAL ANNUAL	0	0	0	0	0	93	95	94

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN 8, CU-38

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	5	7	9
ANNUAL RUNOFF	0	0	0	0	0	93	112	139
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	174	210	260
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	69						460			197
BASIN	33						220			132
PIPES	451						3000			1800
RESIDUAL	82									
NET CAPITAL	470									
									TOTAL	2129

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	3	4
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	5	6
SEWERS (\$1000/YR)	0	0	0	0	0	0	14	14	14
TOTAL (\$1000/YR)	0	0	0	0	0	0	22	24	26
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	164	177	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	24	13	0
NET O.+M. =	38.2725								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	470
O.+M. (\$1000)	38
LAND (\$1000)	2
TOTAL (\$1000)	511

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						35	35	35
BASIN						15	15	15
PIPES						217	217	217
TOTAL O.+M.	0	0	0	0	0	22	24	26
TOTAL ANNUAL	0	0	0	0	0	291	292	295

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN R - CU-34

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	5	11	14	18	20
ANNUAL RUNOFF	0	0	0	85	171	205	256	290
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	320	384	480	543
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	198					670				93
BASIN	94					320				127
PIPES	887					3000				1199
RESIDUAL	55									TOTAL
NET CAPITAL	1125									1421

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	5	7	8	10
SLUDGE	(\$1000/YR)	0	0	0	0	8	9	12	13
SEWERS	(\$1000/YR)	0	0	0	0	14	14	14	14
TOTAL	(\$1000/YR)	0	0	0	0	29	31	35	38
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	213	237	262	0
PRESENT WORTH (\$1000)									
		0	0	0	0	63	35	20	0
NET O.+M. =		118.965							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1125
O.+M. (\$1000)	118
LAND (\$1000)	5
TOTAL (\$1000)	1249

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					51	51	51	51
BASIN					23	23	23	23
PIPES					217	217	217	217
TOTAL O.+M.	0	0	0	0	29	31	35	38
TOTAL ANNUAL	0	0	0	0	321	323	328	330

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN II, CU-42

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	4	4	5	7
ANNUAL RUNOFF	0	0	0	36	72	72	86	107
SLUDGE QUANTITIES (OT/YR)								
SEDIMENT BASIN	0	0	0	0	135	135	161	200
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	118					400				55
BASIN	56					190				75
PIPES	59					200				79
RESIDUAL	8									
NET CAPITAL	225									
									TOTAL	211

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	2	2	3	3
SLUDGE	(\$1000/YR)	0	0	0	0	3	3	4	5
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	0	6	6	8	9
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	48	52	62	0
PRESENT WORTH (\$1000)									
		0	0	0	0	14	7	4	0
NET O.+M. =		26.9897							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	225
O.+M. (\$1000)	26
LAND (\$1000)	1
TOTAL (\$1000)	253

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT					30	30	30	30
BASIN					13	13	13	13
PIPES					14	14	14	14
TOTAL O.+M.	0	0	0	0	6	6	8	9
TOTAL ANNUAL	0	0	0	0	66	66	67	68

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN # . CU-510-52

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	9	19	22	26	30	32	35
ANNUAL RUNOFF	0	161	322	351	381	441	483	529
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	301	603	659	714	826	905	991
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	373				900					0
BASIN	174				420					126
PIPES	82				200					60
RESIDUAL	7									
NET CAPITAL	623									TOTAL 146

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	0	0	0	13	13	15	16	18
SLUDGE	(\$1000/YR)	0	0	0	17	17	20	22	24
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	-----	-----	-----	-----	-----	-----	-----	-----
		0	0	0	32	32	37	40	44
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	132	243	272	297	0
PRESENT WORTH (\$1000)		0	0	0	54	72	41	22	0
NET O.+M. =		190.536							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	623
O.+M. (\$1000)	190
LAND (\$1000)	82
TOTAL (\$1000)	896

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				69	69	69	69	69
BASIN				30	30	30	30	30
PIPES				14	14	14	14	14
TOTAL O.+M.	0	0	0	32	32	37	40	44
TOTAL ANNUAL	0	0	0	146	146	151	154	158

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CURPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - CU-53

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	18	36	37	39	41	43	45
ANNUAL RUNOFF	0	253	506	524	543	581	678	776
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	369	738	765	792	848	989	1132
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	293			505						100
PIPES	276			475						94
RESIDUAL	7									TOTAL 195
NET CAPITAL	562									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	127	135	142	152	178	204
SLUDGE	(\$1000/YR)	0	0	18	19	19	21	24	28
SEWERS	(\$1000/YR)	0	0	2	2	2	2	2	2
TOTAL	(\$1000/YR)	0	0	148	156	165	176	205	234
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	625	659	1158	1340	1545	0
PRESENT WORTH (\$1000)									
		0	0	363	273	354	201	118	0
NET O.+M. =		1311.75							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	562
O.+M. (\$1000)	1311
LAND (\$1000)	166
TOTAL (\$1000)	2040

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			36	36	36	36	36	36
PIPES			34	34	34	34	34	34
TOTAL O.+M.	0	0	148	156	165	176	205	234
TOTAL ANNUAL	0	0	219	227	235	247	276	305

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN N, CU-59

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	14	28	29	30	30	30	30
ANNUAL RUNOFF	0	263	527	556	585	585	585	585
SLUDGE QUANTITIES (OT/YR)								
SEDIMENT BASIN	0	494	988	1042	1096	1096	1096	1096
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	521			820					820	702
BASIN	256			440						87
PIPES	2619			4500						899
TREATMENT PLANT	0							0		0
RESIDUAL	65								TOTAL	1690
NET CAPITAL	3331									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	18	19	20	20	20	20	20
SLUDGE (\$1000/YR)	0	0	24	26	27	27	27	27	27
SEWERS (\$1000/YR)	0	0	22	22	22	22	22	22	22
TOTAL (\$1000/YR)	0	0	65	68	70	70	70	70	70
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	274	283	494	494	494	494	0
PRESENT WORTH (\$1000)	0	0	159	117	144	74	37	0	
NET O.+M. =	535.611								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3331
O.+M. (\$1000)	535
LAND (\$1000)	50
TOTAL (\$1000)	3917

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			63	63	63	63	63	63
BASIN			31	31	31	31	31	31
PIPES			325	325	325	325	325	325
TREATMENT PLANT			0	0	0	0	0	0
TOTAL O.+M.	0	0	65	68	70	70	70	70
TOTAL ANNUAL	0	0	434	408	491	491	491	491

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B - CII-63N

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	5	11	11	12	13	13	13
ANNUAL RUNOFF	0	97	194	200	207	233	233	233
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	181	363	375	388	436	436	436
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PIPE SLUDGE TO MUNICIPAL PLANT

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	343			540					540	462
BASIN	162			280						55
PIPES	1164			2000						399
RESIDUAL	35								TOTAL	916
NET CAPITAL	1635									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	12	12	12	14	14	14
SLUDGE	(\$1000/YR)	0	0	1	1	1	2	2	2
SEWERS	(\$1000/YR)	0	0	9	9	9	9	9	9
TOTAL	(\$1000/YR)	0	0	23	24	24	26	26	26
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	98	100	180	187	187	0
PRESENT WORTH (\$1000)		0	0	57	43	53	28	14	0
NET O.+M. =	195.027								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1635
O.+M. (\$1000)	195
LAND (\$1000)	28
TOTAL (\$1000)	1858

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT			41	41	41	41	41	41
BASIN			20	20	20	20	20	20
PIPES			144	144	144	144	144	144
TOTAL O.+M.	0	0	23	24	24	26	26	26
TOTAL ANNUAL	0	0	230	231	231	233	233	233

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN b. CU-67671

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	7	15	18	21	27	32	39
ANNUAL RUNOFF	0	116	232	272	313	405	486	579
SLUDGE QUANTITIES (OT/YR)								
SEDIMENT-BASIN	0	217	435	510	586	759	911	1085
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	394				950					0
BASIN	182				440					132
PIPES	518				1250					375
RESIDUAL	19									
NET CAPITAL	1075									TOTAL 507

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	10	18	14	17	20
SLUDGE	(\$1000/YR)	0	0	0	14	14	18	22	27
SEWERS	(\$1000/YR)	0	0	0	6	6	6	6	6
TOTAL	(\$1000/YR)	0	0	0	31	38	39	46	53
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	130	250	300	350	0
PRESENT WORTH (\$1000)		0	0	0	54	74	45	24	0
NET O.+M. =	200.158								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1075
O.+M. (\$1000)	200
LAND (\$1000)	44
TOTAL (\$1000)	1319

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT				73	73	73	73	73
BASIN				31	31	31	31	31
PIPES				90	90	90	90	90
TOTAL O.+M.	0	0	0	31	31	39	46	53
TOTAL ANNUAL	0	0	0	227	227	235	241	249

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, CU-73674

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	8	9	12
ANNUAL RUNOFF	0	0	0	0	0	126	153	191
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	236	204	358
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	79						530			227
BASIN	39						260			154
PIPES	215						1430			850
RESIDUAL	48								TOTAL	1241
NET CAPITAL	285									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	4	5	6
SLUDGE (\$1000/YR)	0	0	0	0	0	0	5	7	8
SEWERS (\$1000/YR)	0	0	0	0	0	0	7	7	7
TOTAL (\$1000/YR)	0	0	0	0	0	0	17	19	22
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	130	149	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	19	11	0
NET O.+M.	31.011								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	285
O.+M. (\$1000)	31
LAND (\$1000)	3
TOTAL (\$1000)	319

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						40	40	40
BASIN						18	18	18
PIPES						103	103	103
TOTAL O.+M.	0	0	0	0	0	17	19	22
TOTAL ANNUAL	0	0	0	0	0	180	182	180

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN B - CU-75-76

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	10	11	14
ANNUAL RUNOFF	0	0	0	0	0	154	185	230
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	288	346	431
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	87						580			248
BASIN	42						280			168
PIPES	186						1240			744
RESIDUAL	45									
NET CAPITAL	270									
									TOTAL	1160

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	5	6	8
SLUDGE (\$1000/YR)	0	0	0	0	0	0	7	8	10
SEWERS (\$1000/YR)	0	0	0	0	0	0	6	6	6
TOTAL (\$1000/YR)	0	0	0	0	0	0	18	21	25
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	141	162	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	21	12	0
NET O.+M. =	33.652								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	270
O.+M. (\$1000)	33
LAND (\$1000)	6
TOTAL (\$1000)	309

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						44	44	44
BASIN						20	20	20
PIPES						89	89	89
TOTAL O.+M.	0	0	0	0	0	153	153	153
TOTAL ANNUAL	0	0	0	0	0	173	176	179

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN B - CU-77

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM POND F	0	0	0	0	0	5	6	8
ANNUAL RUNOFF	0	0	0	0	0	87	105	132
SLUDGE QUANTITIES (MT/YR)								
SEDIMENT-BASIN	0	0	0	0	0	163	196	247
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	66						440			168
BASIN	33						220			132
PIPES	33						220			132
RESIDUAL	17									
NET CAPITAL	114									
									TOTAL	452

TABLE II : PRESENT WORTH - O.&amp;M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	3	4
SLUDGE (\$1000/YR)	0	0	0	0	0	0	4	4	6
SEWER (\$1000/YR)	0	0	0	0	0	0	1	1	1
TOTAL (\$1000/YR)	0	0	0	0	0	0	8	9	11
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	62	75	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	9	5	0
NET O.&M.	15.2611								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	114
O.&M. (\$1000)	15
LAND (\$1000)	2
TOTAL (\$1000)	132

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						33	33	33
BASIN						15	15	15
PIPES						15	15	15
TOTAL O.&M.	0	0	0	0	0	8	9	11
TOTAL ANNUAL	0	0	0	0	0	74	75	77

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN B, CU-73-77-31

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	15	18	22
ANNUAL RUNOFF	0	0	0	0	0	224	268	325
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	327	392	474
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	55						370			222
PIPES	812						5400			3341
RESIDUAL	134									
NET CAPITAL	733+									TOTAL 3463

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	0	11	13
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	11
SEWERS (\$1000/YR)	0	0	0	0	0	0	26	26	26
TOTAL (\$1000/YR)	0	0	0	0	0	0	44	43	50
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	325	303	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	48	26	0
NET O.+M. =	75.0073								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	733
O.+M. (\$1000)	75
LAND (\$1000)	14
TOTAL (\$1000)	822

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN						26	26	26
PIPES						370	370	370
TOTAL O.+M.	0	0	0	0	0	44	43	50
TOTAL ANNUAL	0	0	0	0	0	406	403	476

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED DEBTLESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN 0, CU-02

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	1	1	2
ANNUAL RUNOFF	0	0	0	0	0	24	29	36
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	45	54	67
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
TREATMENT PLANT	37						250			197
BASIN	16						110			66
PIPES	90						600			360
RESIDUAL	20									
NET CAPITAL	123									
									TOTAL	533

TABLE II : PRESENT WORTH - O.&M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	0	0	1	1
SLUDGE	(\$1000/YR)	0	0	0	0	0	1	1	1
SEWERS	(\$1000/YR)	0	0	0	0	0	2	2	2
TOTAL	(\$1000/YR)	0	0	0	0	0	4	5	5
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)		0	0	0	0	0	36	39	0
PRESENT WORTH (\$1000)		0	0	0	0	0	0	3	0
NET O.&M. =									2,400.54

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	123
O.&M. (\$1000)	3
LAND (\$1000)	1
TOTAL (\$1000)	133

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
TREATMENT PLANT						10	10	10
BASIN						7	7	7
PIPES						43	43	43
TOTAL O.&M.	0	0	0	0	0	43	5	5
TOTAL ANNUAL	0	0	0	0	0	75	76	76

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## COMPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN # . CU-33

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	3	7	7	7	7	8	8
ANNUAL RUNOFF	0	48	97	98	100	105	113	122
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	70	141	143	146	153	164	178
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	30						205			123
PIPES	285						1900			1140
RESIDUAL	49									
NET CAPITAL	267									
									TOTAL	1263

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	4	4	5
SLUDGE (\$1000/YR)	0	0	0	0	0	0	3	4	4
SEWERS (\$1000/YR)	0	0	0	0	0	0	9	9	9
TOTAL (\$1000/YR)	0	0	0	0	0	0	17	18	19
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	126	131	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	19	10	0
NET O.+M. =	29.1207								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	267
O.+M. (\$1000)	29
LAND (\$1000)	4
TOTAL (\$1000)	300

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN						14	14	14
PIPES						137	137	137
TOTAL O.+M.	0	0	0	0	0	17	18	19
TOTAL ANNUAL	0	0	0	0	0	170	170	171

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN 3 - CU-34

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	5	5	6	6	6	7
ANNUAL RUNOFF	0	29	78	79	81	85	92	98
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	56	113	116	119	124	134	143
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	76				185					55
PIPES	1016				2450					735
RESIDUAL	30									
NET CAPITAL	1062									790

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	4	4	4	4	4	4	5
SLUDGE (\$1000/YR)	0	0	2	2	2	3	3	3	3
SEWERS (\$1000/YR)	0	0	0	12	12	12	12	12	12
TOTAL (\$1000/YR)	0	0	7	19	19	19	19	20	21
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	54	80	138	142	146	146	0
PRESENT WORTH (\$1000)	0	0	31	33	41	21	11	11	0
NET O.+M. =									138.459

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1062
O.+M. (\$1000)	138
LAND (\$1000)	3
TOTAL (\$1000)	1204

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN				13	13	13	13	13
PIPES				177	177	177	177	177
TOTAL O.+M.	0	0	7	19	19	19	20	21
TOTAL ANNUAL	0	0	7	210	210	210	211	211

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# APPENDIX C

This appendix includes all computer printout sheets for the municipal plants and stormwater districts of Plan C except for those municipal plants or stormwater districts which are identical to Plan B. Those which are identical to Plan B are listed below. See Appendix B for those associated computer sheets.

CH - 7	R -8S	CU -20	CU -55
- 8	-10	-25	-56
- 9	-11	-26	-57
-10	-12	-27	-59
-11	-13	-28	-60
-12	-14	-29	-61 E.W.
-13	-15	-30	-62
-14	-16	-31	-63 E.W.
-15	-17	-32	-64 W.NE.SE.
-16	-18	-34A	-65
-17	-19	-35	-66
-18	-20	-36	-67
-19	-21	-37	-68
-20	-22	-38	-69
-21	-23	-39	-70
-22	-24	-40	-71
-23	-25	-41	-72
-24	-26	-42	-73
-25	-27	-43	-74
-26	-28	-44	-75
-27	-29	-45	-76
-28	-30	-46	-77
-29	-31	-47	-78
-30	-32	-48	-79
-31	-33	-49	-80
-32	-34	-50	-81
-33	-35	-51B	-82
-34		-52	-83
-35	CU -13	-53	-84
-36	-19	-54	

Upper East Branch  
Hinckley  
Medina Co.  
New Medina  
Mallet Creek  
Liverpool  
Fowlers Mill  
Newbury Twp.  
Fairmount Road  
Aurora Central  
Chagrin Falls

Chagrin E. Branch  
Chardon  
Butternut Creek  
East Claridon  
Burton  
Troy Twp.  
Auburn Twp.  
Mantua  
Shalersboro  
Randolph  
Ravenna  
Akron

## WASTEWATER TREATMENT PLANT

CORPS OF ENGINEERS - SURVEY SCHEME STUDY

## PLAN C, SOUTHERLY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	563062	600263	632504	715496	703488	878345	923927	926606
FLOW (MGD)								
DOMESTIC	83.87	94.94	101.01	115.47	130.73	146.05	160.99	165.61
INDUSTRIAL	12.78	15.00	17.22	20.55	23.88	24.85	25.80	26.76
TOTAL	101.65	109.94	118.23	136.42	154.61	172.90	186.79	192.37
SLUDGE (TPD)								
GENERATED	107.75	116.54	125.32	144.61	93.95	110.64	0.00	0.00
DISCHARGED	63.96	74.58	80.21	92.55	63.33	70.82	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXPAND TO LEVEL 1	45000		55000							0
SLUDGE FACILITIES	13100		16000							0
SEWERS	16132		19765							1976
SEWERS	13953			23975						4794
SEWERS	4728					15986				6394
RESIDUAL	510									
NET CAPITAL	92403									TOTAL 13154

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	6121	6621	7120	6199	4740	5301	272	280
SLUDGE	(\$1000/YR)	117	1276	1372	1583	1083	1211	0	0
SEWERS	(\$1000/YR)	0	98	218	218	298	298	298	298
TOTAL	(\$1000/YR)	7301	7996	8711	8001	6122	6811 (548)	571	579
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		20072	34251	34262	28954	45420	3929	4041	0
PRESENT WORTH (\$1000)		20072	27955	19940	12013	13435	590	308	0
NET O.+M. =			94313						

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	92403
O.+M. (\$1000)	94313
LAND (\$1000)	1030
TOTAL (\$1000)	187716

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXPAND TO LEVEL 1		4245	4245	4245	4245	4245	4245	
SLUDGE FACILITIES		1235	1235	1235	1235	1235	1235	
SEWERS		1430	1430	1430	1430	1430	1430	1430
SEWERS			1735	1735	1735	1735	1735	1735
SEWERS					1157	1157	1157	1157
TOTAL O.+M.	7301	7996	8711	8001	6122	6311	571	579
TOTAL ANNUAL	7301	14993	17351	16049	15027	16616	10376	1004

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

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HAVENS AND EMERSON LTD CLEVELAND OH

F/G 13/2

WASTEWATER MANAGEMENT STUDY FOR CLEVELAND-AKRON AND THREE RIVER-ETC(U)

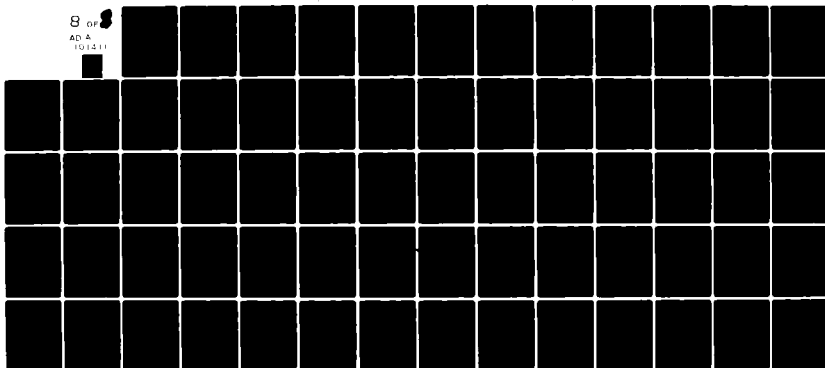
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## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C - ROCKY RIVER

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	61540	75435	89330	100625	111920	125770	137710	143930
FLOW (MGD)								
DOMESTIC	6.77	8.74	10.72	12.35	13.99	16.35	19.28	21.59
INDUSTRIAL	0.37	0.38	0.39	0.39	0.40	0.42	0.44	0.46
TOTAL	7.14	9.12	11.11	12.75	14.39	16.77	19.72	22.05
SLUDGE (TPD)								
GENERATED	5.00	6.39	7.77	8.92	10.08	11.74	0.00	0.00
DISCHARGED	3.20	4.09	4.98	5.71	6.45	7.51	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXPAND TO LEVEL 1	611			1050						0
SLUDGE FACILITIES	559			960						0
RESIDUAL	0									0
NET CAPITAL	1170									0

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	596	762	928	788	577	31	36	40
SLUDGE	(\$1000/YR)	41	53	65	74	84	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	638	816	993	863	662 (26)	31	36	40
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		1908	3709	3807	3128	200	235	267	0
PRESENT WORTH (\$1000)									
		1908	3027	2215	1298	59	35	20	0
NET O.+M. = 8562									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1170
O.+M. (\$1000)	8561
LAND (\$1000)	0
TOTAL (\$1000)	9732

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXPAND TO LEVEL 1			90	90	90	90	90	
SLUDGE FACILITIES			74	74	74	74	74	74
TOTAL O.+M.	638	816	993	863	662	0	0	0
TOTAL ANNUAL	638	816	1157	1027	826	164	164	74

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C . LAKEWOOD

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	80632	86246	91860	98662	105464	116240	123082	124784
FLOW (MGD)								
DOMESTIC	16.92	17.36	17.80	18.29	18.79	18.98	19.77	20.76
INDUSTRIAL	0.19	0.19	0.20	0.20	0.21	0.22	0.23	0.24
TOTAL	17.11	17.55	18.00	18.50	19.00	19.00	20.00	21.00
SLUDGE (TPD)								
GENERATED	18.14	18.61	19.08	19.61	12.16	0.00	0.00	0.00
DISCHARGED	11.61	11.91	12.21	12.55	7.78	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXPANSION	3430		4200							0
EXPAND TO LEVEL 1	1630		2000							0
SLUDGE FACILITIES	2000		2450							0
RESIDUAL	0									0
NET CAPITAL	7060									0

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	1249	1281	1314	1012	693	35	36	38
SLUDGE	(\$1000/YR)	139	142	146	150	93	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	1388	1424	1460	1163	786 (35)	35	36	38
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		3690	5913	5378	3997	246	251	262	0
PRESENT WORTH	(\$1000)	3690	4826	3130	1658	73	37	20	0
NET O.+M. =	13434								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	7060
O.+M. (\$1000)	13434
LAND (\$1000)	0
TOTAL (\$1000)	20494

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXPANSION		324	324	324	324	324	324	
EXPAND TO LEVEL 1		171	171	171	171	171		
SLUDGE FACILITIES		189	189	189	189	189	189	
TOTAL O.+M.	1388	1424	1460	1163	786	35	36	38
TOTAL ANNUAL	1388	2109	2145	1848	1471	720	549	38

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

**WASTEWATER TREATMENT PLANT**
**CORPS OF ENGINEERS - SURVEY SCOPE STUDY**
**PLAN C . WILLOUGHBY-EASTLAKE**

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	38324	45212	52100	64500	76900	97300	115200	124800
FLOW (MGD)								
DOMESTIC	4.22	5.23	6.25	7.93	9.61	12.65	16.13	19.02
INDUSTRIAL	1.33	1.50	1.67	1.84	2.00	2.41	2.83	3.25
TOTAL	5.55	6.73	7.92	9.76	11.61	15.06	18.96	22.27
SLUDGE (TPD)								
GENERATED	3.58	7.14	8.40	10.35	7.43	0.00	0.00	0.00
DISCHARGED	2.29	4.57	5.37	6.62	4.76	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXPANSION	2420			4150						0
SLUDGE FACILITIES	1020		1250							0
SEWERS	489		600							0
SEWERS	1371			2356						60
SEWERS	646					2184				471
RESIDUAL	54									873
NET CAPITAL	5892									TOTAL 1404

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	253	417	621	588	487	27	34	40
SLUDGE	(\$1000/YR)	11	20	21	26	18	0	0	0
SEWERS	(\$1000/YR)	0	2	14	14	25	25	25	25
TOTAL	(\$1000/YR)	264	441	657	629	532 (46)	53	60	66
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		927	2254	2638	2380	323	398	444	0
PRESENT WORTH	(\$1000)	927	1839	1535	987	96	59	33	0
NET O.+M. =	5476								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	5892
O.+M. (\$1000)	5476
LAND (\$1000)	0
TOTAL (\$1000)	11368

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL EXPANSION			320	320	320	320	320	320
SLUDGE FACILITIES		96	96	96	96	96	96	
SEWERS		43	43	43	43	43	43	43
SEWERS			170	170	170	170	170	170
SEWERS				158	158	158	158	158
TOTAL O.+M.	264	441	657	629	532	53	60	66
TOTAL ANNUAL	264	581	1286	1258	1319	840	847	853

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C . NEW KENT

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	33000	48900	64800	81680	98560	121600	139785	150400
FLOW (MGD)								
DOMESTIC	3.63	5.70	7.78	10.05	12.32	15.80	19.57	22.59
INDUSTRIAL	2.20	2.55	2.90	3.25	3.61	4.35	5.08	5.82
TOTAL	5.83	8.25	10.68	13.30	15.93	20.145	24.65	28.41
SLUDGE (TPD)								
GENERATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISCHARGED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
NEW PLANT	160		180					180		128
SEWERS	3917		4800							480
RESIDUAL	23									
NET CAPITAL	4054									
									TOTAL	608

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>
PLANT	(\$1000/YR)	487	15	19	24	29	36	44	51
SLUDGE	(\$1000/YR)	0	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	23	23	23	23	23	23	23
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>487</u>	<u>39</u>	<u>43</u>	<u>48</u>	<u>53</u>	<u>60</u>	<u>68</u>	<u>75</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		690	169	188	207	399	455	508	0
PRESENT WORTH (\$1000)		690	138	109	86	118	68	38	0
NET O.+M. =		1247							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	4054
O.+M. (\$1000)	1247
LAND (\$1000)	520

TOTAL (\$1000) 5821

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL		13	13	13	13	13	13	13
NEW PLANT		347	347	347	347	347	347	347
SEWERS		34	43	48	53	60	68	75
TOTAL O.+M.	487							
TOTAL ANNUAL	487	400	404	409	414	422	430	437

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN C, EASTERLY

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	454765	478288	501812	539314	576616	630533	659688	657573
FLOW (MGD)								
DOMESTIC	113.00	120.15	127.30	130.95	134.60	143.60	148.80	156.10
INDUSTRIAL	12.00	12.35	12.70	13.05	13.40	14.40	15.20	15.90
TOTAL	125.00	132.50	140.00	144.00	148.00	158.00	164.00	172.00
SLUDGE (TPD)								
GENERATED	132.50	140.45	148.40	152.64	94.72	101.12	0.00	0.00
DISCHARGED	84.80	89.89	94.98	97.69	60.62	64.72	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXPAND TO LEVEL 1	12650		15500							0
SLUDGE FACILITIES	10200		12500							0
SEWERS	848			1450						291
RESIDUAL	11									
NET CAPITAL	23687									TOTAL 291

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	7528	7979	8431	6543	4537	4844	239	251
SLUDGE	(\$1000/YR)	1450	1537	1624	1671	1037	1107	0	0
SEWERS	(\$1000/YR)	0	0	7	7	7	7	7	7
TOTAL	(\$1000/YR)	8979	9517	10063	8222	5582	5958 (237)	246	258
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		24270	40143	37487	28300	40529	1690	1773	0
PRESENT WORTH (\$1000)		24270	32764	21817	11741	11988	254	135	0
NET O.+M. =		102969							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	23687
O.+M. (\$1000)	102969
LAND (\$1000)	0
TOTAL (\$1000)	125656

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXPAND TO LEVEL 1		1329	1329	1329	1329	1329		
SLUDGE FACILITIES		964	964	964	964	964	964	
SEWERS			105	105	105	105	105	105
TOTAL O.+M.	8979	9517	10063	3222	5532	5958	246	258
TOTAL ANNUAL	8979	11812	12464	10622	7932	8359	1318	365

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

WASTEWATER TREATMENT PLANT  
PLAN C, EUCLID

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	115110	128864	142618	159028	175439	204550	224617	237036
FLOW (MGD)								
DOMESTIC	12.66	14.88	17.11	19.52	21.93	26.59	31.73	35.55
INDUSTRIAL	1.87	1.93	2.00	2.06	2.12	2.01	1.90	1.79
TOTAL	14.53	16.82	19.11	21.58	24.05	28.60	33.63	37.34
SLUDGE (TPO)								
GENERATED	15.40	17.83	20.26	22.87	15.39	0.00	0.00	0.00
DISCHARGED	9.86	11.41	12.96	14.64	9.85	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXPAND TO LEVEL 1	1550		1900				1900			0
EXPANSION	2860		3500					3500		0
SLUDGE FACILITIES	1960		2460					2400		0
RESIDUAL	0								TOTAL	0
NET CAPITAL	6370									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	1034	1197	1360	1153	860	52	62	68	
SLUDGE (\$1000/YR)	112	130	147	166	112	0	0	0	
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	
TOTAL (\$1000/YR)	1146	1327	1508	1320	972	52	62	68	
					(44)				
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	3246	5812	5799	4701	337	400	456	0	
PRESENT WORTH (\$1000)	3246	4744	3375	1950	100	60	35	0	
NET O.+M. =	13510								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	6370
O.+M. (\$1000)	13510
LAND (\$1000)	360
TOTAL (\$1000)	20240

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXPAND TO LEVEL 1		163	163	163	163	163		
EXPANSION		270	270	270	270	270	270	
SLUDGE FACILITIES		185	185	185	185	185	185	
TOTAL O.+M.	1146	1327	1508	1320	972	52	62	68
TOTAL ANNUAL	1146	1945	2126	1939	1591	670	457	68

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# WASTEWATER TREATMENT PLANT

# COMPS OF ENGINEERS - SURVEY SCOPE STUDY

## LAN C. WETERLY

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	160000	155500	151000	151000	151000	152000	153000	160000
FLOW (MGD)								
DOMESTIC	29.01	28.70	28.40	28.75	29.10	30.09	31.08	32.97
INDUSTRIAL	6.90	7.82	8.74	9.66	10.59	11.13	11.67	12.21
TOTAL	35.91	36.52	37.14	38.41	39.69	41.22	42.75	45.18
SLUDGE (TPD)								
GENERATED	30.88	31.41	31.94	33.04	34.13	35.45	0.00	0.00
DISCHARGED	30.88	31.41	31.94	33.04	34.13	35.45	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
EXPANSION	32700		40000							0
RESIDUAL	0									0
NET CAPITAL	32700									0

TABLE II : PRESENT WORTH - O+M COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	3014	3014	3066	3117	2201	1216	1263	78	82
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
EMERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	3014	3014	3066	3117	2201	1216	1263 (75)	78	82
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	7979	7979	12677	10904	7007	8711	536	563	0
PRESENT WORTH (\$1000)	7979	7979	10347	6346	2907	2576	81	43	0
NET O+M. =	30279								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	32700
O+M. (\$1000)	30279
LAND (\$1000)	0
TOTAL (\$1000)	62979

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL EXPANSION		3431	3431	3431	3431	3431	0	0
TOTAL O+M.	3014	3066	3117	2201	1216	1263	78	82
TOTAL ANNUAL	3014	6498	6549	5633	4648	4695	78	82

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## WASTEWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C, NORTH OLMSTED

	1972	1975	1980	1985	1990	2000	2010	2020
POPULATION	45361	64232	83104	139413	195723	224096	240033	241793
FLOW (MGD)								
DOMESTIC	4.99	11.75	18.52	21.49	24.46	29.14	33.59	35.58
INDUSTRIAL	0.25	0.29	0.33	0.47	0.61	0.63	0.65	0.69
TOTAL	5.24	12.04	18.85	21.96	25.07	29.77	34.24	36.27
SLUDGE (TPD)								
GENERATED	5.55	12.77	19.98	23.28	16.04	0.00	0.00	0.00
DISCHARGED	3.55	8.17	12.79	14.90	10.27	0.00	0.00	0.00

TREATMENT PLANT TYPE : PRELIMINARY TREATMENT

SLUDGE HANDLING TYPE : NONE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUA
EXPANSION	3200			5500						0
EXPANSION	23					80				11
SLUDGE FACILITIES	2610		3200							0
SEWERS	4156			7141						1428
RESIDUAL	56									
NET CAPITAL	9933									TOTAL 1439

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	363	835	1307	1162	915	54	62	66
SLUDGE	(\$1000/YR)	14	32	51	55	35	0	0	0
SEWERS	(\$1000/YR)	0	0	35	35	35	35	35	35
TOTAL	(\$1000/YR)	377	867	1394	1253	985 (80)	90	98	101
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		1634	4637	5426	4590	596	661	702	0
PRESENT WORTH (\$1000)		1634	3784	3158	1904	176	99	53	0
NET O.+M. =		10808							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	9933
O.+M. (\$1000)	10808
LAND (\$1000)	0
TOTAL (\$1000)	20741

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
EXPANSION			424	424	424	424	424	424
EXPANSION					6	6	6	6
SLUDGE FACILITIES		247	247	247	247	247	247	
SEWERS			517	517	517	517	517	517
TOTAL O.+M.	377	867	1394	1253	935	90	98	101
TOTAL ANNUAL	377	1114	2582	2441	2186	1284	1293	1049

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
 NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CH-1+2

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	43	87	89	92	96	103	107
ANNUAL RUNOFF	0	597	1195	1238	1282	1366	1493	1679
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	872	1744	1808	1871	1994	2179	2451
TREATMENT PLANT	0	0	728	755	782	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	523			900						179
PIPES	291			500						99
RESIDUAL	10									
NET CAPITAL	803									
									TOTAL	279

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	296	245	189	45	49	55
SLUDGE	(\$1000/YR)	0	0	48	50	52	49	54	61
SEWERS	(\$1000/YR)	0	0	2	2	2	2	2	2
TOTAL	(\$1000/YR)	0	0	347	298	244	97	106	119
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	1323	1112	1200	715	791	0
PRESENT WORTH (\$1000)		0	0	770	461	355	107	60	0
NET O.+M. =	1755.41								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	803
O.+M. (\$1000)	1755
LAND (\$1000)	700
TOTAL (\$1000)	3259

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			65	65	65	65	65	65
PIPES			36	36	36	36	36	36
TOTAL O.+M.	0	0	347	298	244	97	106	119
TOTAL ANNUAL	0	0	448	399	345	198	207	220

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C . CM-3

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	4	9	11	14	19	24	24
ANNUAL RUNOFF	0	72	145	181	218	291	363	363
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	318	424	529	529
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	145				350					105
PIPES	124				300					90
RESIDUAL	7									
NET CAPITAL	262									195
									TOTAL	

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	25	25	9	11	11
SLUDGE	(\$1000/YR)	0	0	0	7	7	10	13	13
SEWERS	(\$1000/YR)	0	0	0	1	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	34	34	21	26	26
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	141	197	170	187	0
PRESENT WORTH (\$1000)		0	0	0	58	58	25	14	0
NET O.+M. =	157.101								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	262
O.+M. (\$1000)	157
LAND (\$1000)	73
TOTAL (\$1000)	492

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL				25	25	25	25	25
BASIN				21	21	21	21	21
PIPES				34	34	21	26	26
TOTAL O.+M.	0	0	0	81	81	68	73	73
TOTAL ANNUAL	0	0	0	81	81	68	73	73

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CH-4

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	1	3	5	7	10
ANNUAL RUNOFF	0	0	0	30	60	89	119	149
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	87	129	173	217
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	62					210				83
PIPES	88					300				119
RESIDUAL	7									
NET CAPITAL	142									203
									TOTAL	

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	1	2	3	4
SLUDGE	(\$1000/YR)	0	0	0	0	2	3	4	5
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	5	7	9	11
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	46	61	75	0
PRESENT WORTH (\$1000)									
		0	0	0	0	13	9	5	0
NET O.+M. = 28.8952									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	142
O.+M. (\$1000)	28
LAND (\$1000)	11
TOTAL (\$1000)	182

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					15	15	15	15
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	5	7	9	11
TOTAL ANNUAL	0	0	0	0	42	44	46	48

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CH-5

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	6	10	12
ANNUAL RUNOFF	0	0	0	0	0	108	162	194
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	157	234	283
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	37									
PIPES	45						250			150
							300			180
RESIDUAL	12									
NET CAPITAL	69									
									TOTAL	330

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	3	5	6
SLUDGE (\$1000/YR)	0	0	0	0	0	0	3	5	7
SEWERS (\$1000/YR)	0	0	0	0	0	0	1	1	1
TOTAL (\$1000/YR)	0	0	0	0	0	0	9	12	14
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	0	0	76	97	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	11	7	0
NET O.+M. =	18.9386								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	69
O.+M. (\$1000)	18
LAND (\$1000)	15
TOTAL (\$1000)	103

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN						18	18	18
PIPES						21	21	21
TOTAL O.+M.	0	0	0	0	0	9	12	14
TOTAL ANNUAL	0	0	0	0	0	48	52	54

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN C, CH-6

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	3	6	11	15	18
ANNUAL RUNOFF	0	0	0	53	106	161	214	267
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	154	235	312	389
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	88					300				119
PIPES	88					300				119
RESIDUAL	9									
NET CAPITAL	168									
									TOTAL	239

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	0	0	0	0	3	5	7	8
SLUDGE	(\$1000/YR)	0	0	0	0	3	5	7	9
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	8	12	16	20
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	75	102	127	0
PRESENT WORTH (\$1000)		0	0	0	0	22	15	9	0
NET O.+M. =	47.5161								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	168
O.+M. (\$1000)	47
LAND (\$1000)	20
TOTAL (\$1000)	235

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					21	21	21	21
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	8	12	16	20
TOTAL ANNUAL	0	0	0	0	52	56	59	63

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, R-1445

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	14	29	29	29	30	30	30
ANNUAL RUNOFF	0	262	524	524	524	579	579	579
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	262	524	524	524	579	579	579
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	1658			2850						569
PIPES	407			700						139
RESIDUAL	27									709
NET CAPITAL	2038									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	35	35	35	39	39	39	39
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	3	3	3	3	3	3	3
TOTAL (\$1000/YR)	0	0	39	39	39	42	42	42	42
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	160	160	288	301	301	301	0
PRESENT WORTH (\$1000)	0	0	93	66	85	45	23	0	0
NET O.+M. =	313.844								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2038
O.+M. (\$1000)	313
LAND (\$1000)	20
TOTAL (\$1000)	2372

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			206	206	206	206	206	206
PIPES			50	50	50	50	50	50
TOTAL O.+M.	0	0	39	39	39	42	42	42
TOTAL ANNUAL	0	0	296	296	296	299	299	299

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN C, R-3

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	11	22	22	23	23	24	24
ANNUAL RUNOFF	0	160	321	325	330	352	385	385
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	160	321	325	330	352	385	385
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	1326			2280						455
PIPES	116			200						39
RESIDUAL	19									
NET CAPITAL	1424									TOTAL 495

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	21	22	22	23	26	26
SLUDGE	(\$1000/YR)	0	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	22	23	23	24	27	27
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	94	95	170	183	191	0
PRESENT WORTH (\$1000)		0	0	54	39	50	27	14	0
NET O.+M. =	187.078								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1424
O.+M. (\$1000)	187
LAND (\$1000)	42
TOTAL (\$1000)	1653

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			165	165	165	165	165	165
PIPES			14	14	14	14	14	14
TOTAL O.+M.	0	0	22	23	23	24	27	27
TOTAL ANNUAL	0	0	202	202	203	204	206	206

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, R-6+7+8N

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	28	56	62	69	74	78	78
ANNUAL RUNOFF	0	384	769	862	955	1027	1098	1098
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	561	1122	1258	1394	1499	1603	1603
TREATMENT PLANT	0	0	469	525	582	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	209			360						71
BASIN	83				202					60
PIPES	6776			11644						2328
RESIDUAL	95									
NET CAPITAL	6974									
									TOTAL	2461

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	171	153	127	33	36	36	36
SLUDGE (\$1000/YR)	0	0	31	33	34	37	40	40	40
SEWERS (\$1000/YR)	0	0	58	58	58	58	58	58	58
TOTAL (\$1000/YR)	0	0	261	244	220	129	134	134	134
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	1037	953	1228	927	944	0	0
PRESENT WORTH (\$1000)	0	0	603	395	363	139	72	0	0
NET O.+M. =	1574.24								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	6974
O.+M. (\$1000)	1574
LAND (\$1000)	77
TOTAL (\$1000)	8625

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			26	26	26	26	26	26
BASIN				14	14	14	14	14
PIPES			843	843	843	843	843	843
TOTAL O.+M.	0	0	261	244	220	129	134	134
TOTAL ANNUAL	0	0	1130	1128	1103	1013	1018	1018

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C . R-89

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	2	2	2	2	2	2	2	2
ANNUAL RUNOFF	38	39	41	41	41	41	41	41
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	22	23	23	23	23	23	23	23
TREATMENT PLANT	8	9	9	9	9	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	465		570							57
PIPES	163		200							20
RESIDUAL	2									
NET CAPITAL	625									TOTAL 77

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	7	8	7	6	2	2	2	2
SLUDGE (\$1000/YR)	0	0	0	0	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	9	9	8	8	3	3	3	3
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	37	37	34	41	26	26	0	0
PRESENT WORTH (\$1000)	0	30	21	14	12	4	2	0	0
NET O.+M. =	84.9265								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	625
O.+M. (\$1000)	84
LAND (\$1000)	11
TOTAL (\$1000)	721

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		41	41	41	41	41	41	41
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	9	9	8	8	3	3	3
TOTAL ANNUAL	0	64	65	64	63	59	59	59

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C - LE-1

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	24	48	49	50	53	55	55
ANNUAL RUNOFF	0	340	681	738	795	909	1022	1022
SLUDGE QUANTITIES (OT/YR)								
SEDIMENT-BASIN	0	638	1276	1383	795	909	1022	1022
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	2979			5120						1023
PIPES	2037			3500						499
RESIDUAL	66									
NET CAPITAL	4949									
									TOTAL	1723

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	0	0	158	111	54	61	69	69
SLUDGE	(\$1000/YR)	0	0	8	4	0	0	0	0
SEWERS	(\$1000/YR)	0	0	17	17	17	17	17	17
TOTAL	(\$1000/YR)	0	0	185	133	71	79	87	87
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	453	420	530	584	611	0
PRESENT WORTH (\$1000)		0	0	380	174	156	87	46	0
NET O.+M. =		846.166							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	4949
O.+M. (\$1000)	846
LAND (\$1000)	20
TOTAL (\$1000)	5816

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			370	370	370	370	370	370
PIPES			253	253	253	253	253	253
TOTAL O.+M.	0	0	185	133	71	79	87	87
TOTAL ANNUAL	0	0	809	757	695	703	711	711

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN C, L3-2

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	18	37	38	39	41	41	41
ANNUAL RUNOFF	0	294	589	631	673	757	757	757
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	552	1104	1183	673	757	757	757
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	2328			4000						799
PIPES	2153			3700						739
RESIDUAL	59									
NET CAPITAL	4421									
									TOTAL	1539

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	137	94	45	51	51	51
SLUDGE	(\$1000/YR)	0	0	7	4	0	0	0	0
SEWERS	(\$1000/YR)	0	0	18	18	18	18	18	18
TOTAL	(\$1000/YR)	0	0	163	117	64	70	70	70
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	576	373	471	492	492	0
PRESENT WORTH (\$1000)		0	0	335	154	139	73	37	0
NET O.+M. =	741.408								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	4421
O.+M. (\$1000)	741
LAND (\$1000)	20
TOTAL (\$1000)	5183

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			289	289	289	289	289	289
PIPES			267	267	267	267	267	267
TOTAL O.+M.	0	0	163	117	64	70	70	70
TOTAL ANNUAL	0	0	720	675	621	627	627	627

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C, LE-3

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	33	67	68	70	73	73	73
ANNUAL RUNOFF	0	525	1050	1125	1200	1350	1350	1350
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	766	1533	1642	1200	1350	1350	1350
TREATMENT PLANT	0	0	640	686	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	3980			6840						1367
PIPES	2211			3800						759
RESIDUAL	82									
NET CAPITAL	6109									TOTAL 2127

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	276	242	201	91	91	91	91
SLUDGE (\$1000/YR)	0	0	14	13	7	0	0	0	0
SEWERS (\$1000/YR)	0	0	18	18	18	18	18	18	18
TOTAL (\$1000/YR)	0	0	309	274	228	110	110	110	110
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	1197	1031	1192	779	779	779	0
PRESENT WORTH (\$1000)	0	0	696	427	352	117	59	59	0
NET O.+M. =	1654.05								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	6109
O.+M. (\$1000)	1654
LAND (\$1000)	30
TOTAL (\$1000)	7793

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			495	495	495	495	495	495
PIPES			275	275	275	275	275	275
TOTAL O.+M.	0	0	309	274	228	110	110	110
TOTAL ANNUAL	0	0	1079	1044	998	881	881	881

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN C, LE-4

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	81	162	166	171	179	188	197
ANNUAL RUNOFF	0	1116	2237	2325	2414	2816	3219	3621
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	1633	3266	3395	2414	2816	3219	3621
TREATMENT PLANT	0	0	1364	1418	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	10941			18800						3759
PIPES	494			850						169
RESIDUAL	152									
NET CAPITAL	11283									TOTAL 3929

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	521	466	405	191	218	246
SLUDGE	(\$1000/YR)	0	0	23	20	12	0	0	0
SEWERS	(\$1000/YR)	0	0	4	4	4	4	4	4
TOTAL	(\$1000/YR)	0	0	548	491	421	196	223	250
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	2131	1671	2169	1473	1465	0
PRESENT WORTH (\$1000)		0	0	1240	776	641	221	127	0
NET O.+M. =	3007.59								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	11283
O.+M. (\$1000)	3007.59
LAND (\$1000)	50
TOTAL (\$1000)	14341

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			1361	1361	1361	1361	1361	1361
PIPES			61	61	61	61	61	61
TOTAL O.+M.	0	0	548	491	421	196	223	250
TOTAL ANNUAL	0	0	1971	1913	1844	1618	1644	1673

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, LE-5

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	297	298	299	299	299	299	299	299
ANNUAL RUNOFF	5364	5425	5486	5486	5486	5486	5486	5486
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	3137	3173	3209	3209	3209	3209	3209	3209
TREATMENT PLANT	1233	1247	1261	1261	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	23241		28500							2850
PIPES	10692		13100							1310
RESIDUAL	161									
NET CAPITAL	33792									
									TOTAL	4160

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	1264	1278	1099	921	373	373	373	373
SLUDGE (\$1000/YR)	0	22	22	19	16	0	0	0	0
SEWERS (\$1000/YR)	0	65	65	65	65	65	65	65	65
TOTAL (\$1000/YR)	0	1351	1366	1184	1003	438	438	438	438
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	5571	5229	4485	5064	3082	3082	0	0
PRESENT WORTH (\$1000)	0	4547	3043	1860	1497	463	235	0	0
NET O.+M. =	11648.7								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	33792
O.+M. (\$1000)	11648
LAND (\$1000)	80
TOTAL (\$1000)	45521

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		2063	2063	2063	2063	2063	2063	2063
PIPES		948	948	948	948	948	948	948
TOTAL O.+M.	0	1351	1366	1184	1003	438	438	438
TOTAL ANNUAL	0	4363	4377	4196	4015	3450	3450	3450

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C. LE-6

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	70	70	70	70	70	70	70	70
ANNUAL RUNOFF	1453	1453	1453	1453	1453	1453	1453	1453
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	850	850	850	850	850	850	850	850
TREATMENT PLANT	334	334	334	334	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	5346		6550							655
PIPES	6611		8100							810
RESIDUAL	56									
NET CAPITAL	11900									1465

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	338	338	218	98	98	98	98	98
SLUDGE (\$1000/YR)	0	5	5	5	4	0	0	0	0
SEWERS (\$1000/YR)	0	40	40	40	40	40	40	40	40
TOTAL (\$1000/YR)	0	384	384	265	143	139	139	139	139
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	1578	1332	837	993	978	978	0	0
PRESENT WORTH (\$1000)	0	1288	775	347	293	147	74	0	0
NET O.+M. =	2927.45								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	11900
O.+M. (\$1000)	2927
LAND (\$1000)	25
TOTAL (\$1000)	14852

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		474	474	474	474	474	474	474
PIPES		586	586	586	586	586	586	586
TOTAL O.+M.	0	384	384	265	143	139	139	139
TOTAL ANNUAL	0	1445	1445	1325	1204	1200	1200	1200

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, LE-7

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	51	51	51	52	53	53	53	53
ANNUAL RUNOFF	969	969	969	1000	1031	1031	1031	1031
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	566	566	566	584	603	603	603	603
TREATMENT PLANT	222	222	222	230	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	4187		5130							513
PIPES	81		100							10
RESIDUAL	20									
NET CAPITAL	4248									TOTAL 523

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	225	225	150	70	70	70	70	70
SLUDGE (\$1000/YR)	0	3	3	3	3	3	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	230	230	154	73	70	70	70	70
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	943	788	467	506	496	496	0	0
PRESENT WORTH (\$1000)	0	770	459	194	149	74	37	0	0
NET O.+M. *	1685.97								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	4248
O.+M. (\$1000)	1685
LAND (\$1000)	20
TOTAL (\$1000)	5954

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		371	371	371	371	371	371	371
PIPES		7	7	7	7	7	7	7
TOTAL O.+M.	0	230	230	154	73	70	70	70
TOTAL ANNUAL	0	608	608	533	452	449	449	449

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C - LE-8

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	17	35	35	35	35	35	35
ANNUAL RUNOFF	0	328	656	656	656	656	656	656
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	615	1230	1230	656	656	656	656
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	1990			3420						683
PIPES	2956			5080						1015
RESIDUAL	65									
NET CAPITAL	4881									
									TOTAL	1699

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	152	98	44	44	44	44	44
SLUDGE (\$1000/YR)	0	0	8	4	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	25	25	25	25	25	25	25
TOTAL (\$1000/YR)	0	0	186	128	70	70	70	70	70
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	646	407	492	492	492	492	0
PRESENT WORTH (\$1000)	0	0	376	168	145	74	37	0	0
NET O.+M. =	802.354								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	4881
O.+M. (\$1000)	802
LAND (\$1000)	20
TOTAL (\$1000)	5703

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			247	247	247	247	247	247
PIPES			367	367	367	367	367	367
TOTAL O.+M.	0	0	186	128	70	70	70	70
TOTAL ANNUAL	0	0	802	743	685	685	685	685

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CUMPS OF ENGINEERS - SURVLY SCOPE STUDY

## PLAN C, LE-9

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	18	37	38	39	39	39	39
ANNUAL RUNOFF	0	265	531	575	619	619	619	691
SLUDGE QUANTITIES (DY/YR)								
SEDIMENT-BASIN	0	387	775	839	619	619	619	691
TREATMENT PLANT	0	0	323	350	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	2159			3710						741
PIPES	2793			4800						959
RESIDUAL	66									
NET CAPITAL	4886									TOTAL 1701

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	139	123	103	42	42	42	46
SLUDGE (\$1000/YR)	0	0	25	13	0	0	0	0	0
SEWERS (\$1000/YR)	0	0	23	23	23	23	23	23	23
TOTAL (\$1000/YR)	0	0	187	161	126	66	66	66	71
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	718	593	682	464	461	461	0
PRESENT WORTH (\$1000)	0	0	418	246	201	69	36	36	0
NET O.+M. =	973.119								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	4886
O.+M. (\$1000)	973
LAND (\$1000)	15
TOTAL (\$1000)	5874

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			268	268	268	268	268	268
PIPES			347	347	347	347	347	347
TOTAL O.+M.	0	0	188	161	128	66	66	71
TOTAL ANNUAL	0	0	805	777	744	682	682	687

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, LE-10

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	24	49	49	50	53	55	56
ANNUAL RUNOFF	0	338	670	686	696	747	799	799
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	633	1267	1286	696	747	799	799
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	3148			5410						1081
PIPES	4103			7050						1409
RESIDUAL	96									
NET CAPITAL	7155									
									TOTAL	2491

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	157	103	47	50	54	54
SLUDGE	(\$1000/YR)	0	0	29	14	0	0	0	0
SEWERS	(\$1000/YR)	0	0	35	35	35	35	35	35
TOTAL	(\$1000/YR)	0	0	221	153	82	86	89	89
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	769	483	592	617	629	0
PRESENT WORTH (\$1000)		0	0	447	200	175	92	48	0
NET O.+M. =	964.73								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	7155
O.+M. (\$1000)	964
LAND (\$1000)	15
TOTAL (\$1000)	8134

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			391	391	391	391	391	391
PIPES			510	510	510	510	510	510
TOTAL O.+M.	0	0	221	153	82	86	89	89
TOTAL ANNUAL	0	0	1124	1055	984	998	991	991

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C - LE-11+12

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	26	53	55	58	65	73	76
ANNUAL RUNOFF	0	368	737	779	822	933	1043	1089
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	368	737	779	822	933	1043	1089
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	3074									
PIPES	82				7410					2223
					200					60
RESIDUAL	88									
NET CAPITAL	3068									TOTAL 2283

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	0	0	0	55	55	63	70	74
SLUDGE	(\$1000/YR)	0	0	0	0	0	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	0	0	56	56	64	72	75
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	233	426	479	516	0
PRESENT WORTH (\$1000)		0	0	0	96	126	72	39	0
NET O.+M. =		334.774							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3068
O.+M. (\$1000)	334
LAND (\$1000)	61
TOTAL (\$1000)	3464

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN				536	536	536	536	536
PIPES				14	14	14	14	14
TOTAL O.+M.	0	0	0	56	56	64	72	75
TOTAL ANNUAL	0	0	0	607	607	615	622	626

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED LIABILITY

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-1

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	32	32	32	32	33	33	33	33
ANNUAL RUNOFF	631	631	631	637	644	644	644	644
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	369	369	369	372	376	376	376	376
TREATMENT PLANT	145	145	145	146	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	2562		3140							314
PIPES	163		200							20
RESIDUAL	12									
NET CAPITAL	2713									TOTAL 334

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	147	147	95	43	43	43	43	43
SLUDGE (\$1000/YR)	0	2	2	2	1	0	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	150	150	99	46	44	44	44	44
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	617	512	299	321	314	314	314	0
PRESENT WORTH (\$1000)	0	503	298	124	95	47	24	24	0
NET O.+M. =	1092.49								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2713
O.+M. (\$1000)	1092
LAND (\$1000)	80
TOTAL (\$1000)	3885

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		227	227	227	227	227	227	227
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	150	150	99	46	44	44	44
TOTAL ANNUAL	0	392	392	340	268	266	266	266

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C, CU-2

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	61	61	61	61	62	62	62	62
ANNUAL RUNOFF	1147	1147	1147	1183	1220	1220	1220	1220
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	670	670	670	692	713	713	713	713
TREATMENT PLANT	263	263	263	272	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	4889		5990							599
PIPES	163		200							20
RESIDUAL	24									
NET CAPITAL	5028									TOTAL 619

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	267	267	178	82	82	82	82
SLUDGE	(\$1000/YR)	0	4	4	4	3	0	0	0
SEWERS	(\$1000/YR)	0	0	0	0	0	0	0	0
TOTAL	(\$1000/YR)	0	272	272	183	87	84	84	84
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	1119	935	555	602	590	590	0
PRESENT WORTH (\$1000)		0	913	544	230	178	88	45	0
NET O.+M. =	2000.02								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	5028
O.+M. (\$1000)	2000
LAND (\$1000)	25
TOTAL (\$1000)	7053

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		433	433	433	433	433	433	433
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	272	272	183	87	84	84	84
TOTAL ANNUAL	0	721	721	631	535	532	532	532

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN C. CU-3

CURPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	43	43	43	44	45	45	45	45
ANNUAL RUNOFF	742	742	742	788	835	835	835	835
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	434	434	434	461	488	488	488	488
TREATMENT PLANT	170	170	170	181	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	3493		4280							428
PIPES	163		200							20
RESIDUAL	17									
NET CAPITAL	3639									TOTAL 448

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	172	172	118	56	56	56	56	56
SLUDGE (\$1000/YR)	0	3	3	2	2	0	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	176	176	122	60	57	57	57	57
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	725	613	374	414	406	406	0	0
PRESENT WORTH (\$1000)	0	592	357	155	122	61	31	0	0
NET O.+M. =	1319.28								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	3639
O.+M. (\$1000)	1319
LAND (\$1000)	20
TOTAL (\$1000)	4978

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		309	309	309	309	309	309	309
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	176	176	122	60	57	57	57
TOTAL ANNUAL	0	501	501	446	384	382	382	382

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C, CU-4A

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	30	31	32	32	33	34	35	35
ANNUAL RUNOFF	424	462	500	513	527	575	642	642
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	248	270	292	300	308	336	375	375
TREATMENT PLANT	97	106	115	118	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	2791		3420							342
PIPES	11018		13500							1350
RESIDUAL	65									TOTAL 1692
NET CAPITAL	13744									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	0	107	116	77	35	39	43	43
SLUDGE	(\$1000/YR)	0	1	2	1	1	0	0	0
SEWERS	(\$1000/YR)	0	67	67	67	67	67	67	67
TOTAL	(\$1000/YR)	0	177	186	146	104	106	111	111
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	744	681	515	742	764	780	0
PRESENT WORTH (\$1000)		0	607	396	213	219	115	59	0
NET O.+M. =		1612.66							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	13744
O.+M. (\$1000)	1612
LAND (\$1000)	50
TOTAL (\$1000)	15407

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		247	247	247	247	247	247	247
PIPES		977	977	977	977	977	977	977
TOTAL O.+M.	0	177	186	146	104	106	111	111
TOTAL ANNUAL	0	1402	1411	1371	1329	1331	1336	1336

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

### PLAN C - CU-4B+C+D

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	230	237	245	247	249	256	269	269
ANNUAL RUNOFF	3240	3540	3840	3945	4050	4400	4940	4940
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	5168	5606	5759	5913	6424	7212	7212
TREATMENT PLANT	0	0	2342	2406	2470	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	785			1350						269
PIPES	931			1600						319
RESIDUAL	22									
NET CAPITAL	1694									589

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	760	621	473	514	163	163	163
SLUDGE (\$1000/YR)	0	0	151	156	160	160	180	180	180
SEWERS (\$1000/YR)	0	0	7	7	7	7	7	7	7
TOTAL (\$1000/YR)	0	0	920	785	642	683	351	351	351
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	3496	2926	4654	3633	2467	0	0
PRESENT WORTH (\$1000)	0	0	2034	1214	1376	546	188	0	0
NET O.+M. =	5360.87								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1694
O.+M. (\$1000)	5360
LAND (\$1000)	1800
TOTAL (\$1000)	8854

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			97	97	97	97	97	97
PIPES			115	115	115	115	115	115
TOTAL O.+M.	0	0	920	785	642	683	351	351
TOTAL ANNUAL	0	0	1133	998	855	896	544	544

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C . CU-5

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	141	144	147	148	150	154	162	162
ANNUAL RUNOFF	2044	2175	2307	2373	2439	2637	2967	2967
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	1195	1272	1349	1388	1426	1542	1735	1735
TREATMENT PLANT	470	500	530	545	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

STORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	12569		15400							1540
PIPES	163		200							20
RESIDUAL	60									
NET CAPITAL	12672									TOTAL 1560

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	506	537	357	165	179	201	201	
SLUDGE (\$1000/YR)	0	8	9	8	7	0	0	0	0
SEWERS (\$1000/YR)	0	0	0	0	0	0	0	0	0
TOTAL (\$1000/YR)	0	516	547	366	173	180	202	202	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	2182	1874	1107	1244	1346	1425	0	
PRESENT WORTH (\$1000)	0	1781	1090	459	368	202	108	0	
NET O.+M. =	4011.71								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	12672
O.+M. (\$1000)	4011
LAND (\$1000)	346
TOTAL (\$1000)	17029

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN		1114	1114	1114	1114	1114	1114	1114
PIPES		14	14	14	14	14	14	14
TOTAL O.+M.	0	516	547	366	173	180	202	202
TOTAL ANNUAL	0	1646	1677	1495	1303	1309	1332	1332

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C. CU-6 12

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	38	39	41	42	44	47	49	49
ANNUAL RUNOFF	526	547	568	600	633	677	790	790
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	798	829	876	924	988	1153	1153
TREATMENT PLANT	0	0	346	366	386	412	481	481

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : SOLIDS TO TUNNEL

TORAGE BASIN : CONCRETE

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	5470			9400						1879
PIPES	954			1640						327
RESIDUAL	85									TOTAL 2207
NET CAPITAL	6339									

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
LAND (\$1000/YR)	0	0	112	105	96	102	53	53	
SLUDGE (\$1000/YR)	0	0	5	6	6	4	0	0	
SEWERS (\$1000/YR)	0	0	8	8	8	8	8	8	
TOTAL (\$1000/YR)	0	0	126	119	110	116	62	62	
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	504	472	797	625	435	0	
PRESENT WORTH (\$1000)	0	0	293	156	235	94	33	0	
NET O.+M. =	852.754								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	6339
O.+M. (\$1000)	852
LAND (\$1000)	105
TOTAL (\$1000)	7297

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			680	680	680	680	680	680
PIPES			118	118	118	118	118	118
TOTAL O.+M.	0	0	126	119	110	116	62	62
TOTAL ANNUAL	0	0	925	918	910	915	861	861

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-7+18

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	7	15	19	23	30	37	46
ANNUAL RUNOFF	0	111	223	278	334	446	577	660
SLUDGE QUANTITIES (D7/YR)								
SEDIMENT BASIN	0	162	325	406	487	651	842	963
TREATMENT PLANT	0	0	136	169	203	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	236				570					171
PIPES	1452				3500					1050
RESIDUAL	47									
NET CAPITAL	1641									TOTAL 1221

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		---	---	---	---	---	---	---	---
PLANT	(\$1000/YR)	0	0	0	39	39	52	19	21
SLUDGE	(\$1000/YR)	0	0	0	13	13	16	21	24
SEWERS	(\$1000/YR)	0	0	0	17	17	17	17	17
TOTAL	(\$1000/YR)	0	0	0	69	69	85	57	63
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	286	546	504	424	0
PRESENT WORTH (\$1000)		0	0	0	118	161	75	32	0
NET O.+M. =	388.787								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1641
O.+M. (\$1000)	388
LAND (\$1000)	288
TOTAL (\$1000)	2318

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN				41	41	41	41	41
PIPES				253	253	253	253	253
TOTAL O.+M.	0	0	0	69	69	85	57	63
TOTAL ANNUAL	0	0	0	364	364	380	352	358

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-8

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	42	84	86	89	93	98	98
ANNUAL RUNOFF	0	577	1155	1199	1243	1296	1386	1386
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	843	1686	1750	1814	1892	2023	2023
TREATMENT PLANT	0	0	704	731	758	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	477			820						163
PIPES	174			300						59
RESIDUAL	8									
NET CAPITAL	643									223

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	228	188	145	151	45	45
SLUDGE	(\$1000/YR)	0	0	45	47	49	47	50	50
SEWERS	(\$1000/YR)	0	0	1	1	1	1	1	1
TOTAL	(\$1000/YR)	0	0	275	237	196	200	97	97
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	1052	889	1392	1047	687	0
PRESENT WORTH (\$1000)									
		0	0	612	369	411	157	52	0
NET O.+M. = 1603.78									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	643
O.+M. (\$1000)	1603
LAND (\$1000)	591
TOTAL (\$1000)	2837

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			59	59	59	59	59	59
PIPES			21	21	21	21	21	21
TOTAL O.+M.	0	0	275	237	196	200	97	97
TOTAL ANNUAL	0	0	356	318	277	281	178	178

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

# CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C - CU-9

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	0	4	6	7
ANNUAL RUNOFF	0	0	0	0	0	74	89	112
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	0	108	129	163
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	33						220			132
PIPES	300						2000			1200
RESIDUAL	51									
NET CAPITAL	282									TOTAL 1332

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	0	0	2	2	3
SLUDGE (\$1000/YR)	0	0	0	0	0	0	2	3	4
SEWERS (\$1000/YR)	0	0	0	0	0	0	9	9	9
TOTAL (\$1000/YR)	0	0	0	0	0	0	15	14	17
PRESENT VALUE AT BEGINNING OF PERIOD (\$1000)	0	0	0	0	0	0	110	119	0
PRESENT WORTH (\$1000)	0	0	0	0	0	0	16	9	0
NET O.+M. =	25.6606								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	282
O.+M. (\$1000)	25
LAND (\$1000)	24
TOTAL (\$1000)	331

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN						15	15	15
PIPES						144	144	144
TOTAL O.+M.	0	0	0	0	0	15	16	17
TOTAL ANNUAL	0	0	0	0	0	175	176	176

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-10

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	5	6	8	11
ANNUAL RUNOFF	0	0	0	40	80	97	121	162
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	116	141	176	236
TREATMENT PLANT	0	0	0	0	48	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	79					270				107
PIPES	88					300				119
RESIDUAL	8									
NET CAPITAL	159									
									TOTAL	277

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	9	11	3	5
SLUDGE	(\$1000/YR)	0	0	0	0	3	3	4	5
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	2
TOTAL	(\$1000/YR)	0	0	0	0	14	16	9	12
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	0	106	92	79	0
PRESENT WORTH	(\$1000)	0	0	0	0	31	13	6	0
NET O.+M. =	\$1.5649								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	159
O.+M. (\$1000)	51
LAND (\$1000)	34
TOTAL (\$1000)	245

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					19	19	19	19
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	14	16	9	12
TOTAL ANNUAL	0	0	0	0	55	57	51	54

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C - CU-11

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	12	24	24	24	26	27	27
ANNUAL RUNOFF	0	168	337	341	346	370	432	432
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	246	492	498	505	540	630	630
TREATMENT PLANT	0	0	205	208	211	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	261			450						89
PIPES	174			300						59
RESIDUAL	5									
NET CAPITAL	430									149

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		-----	-----	-----	-----	-----	-----	-----	-----
PLANT	(\$1000/YR)	0	0	66	53	40	43	14	14
SLUDGE	(\$1000/YR)	0	0	13	13	13	13	15	15
SEWERS	(\$1000/YR)	0	0	1	1	1	1	1	1
TOTAL	(\$1000/YR)	0	0	81	68	55	58	31	31
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	308	255	400	315	221	0
PRESENT WORTH (\$1000)		0	0	179	105	118	47	16	0
NET O.+M. =	467.978								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	430
O.+M. (\$1000)	467
LAND (\$1000)	184
TOTAL (\$1000)	1082

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			32	32	32	32	32	32
PIPES			21	21	21	21	21	21
TOTAL O.+M.	0	0	81	68	55	58	31	31
TOTAL ANNUAL	0	0	135	123	109	112	85	85

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING RUMVED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN C, CU-18

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	15	31	31	32	33	35	35
ANNUAL RUNOFF	0	212	425	435	446	466	500	500
SLUDGE QUANTITIES (DY/YR)								
SEDIMENT BASIN	0	310	620	635	651	680	730	730
TREATMENT PLANT	0	0	259	265	272	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	203				490					147
PIPES	601				1450					435
RESIDUAL	22									
NET CAPITAL	782									502

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	52	52	54	56	56	16
SLUDGE (\$1000/YR)	0	0	0	17	17	17	17	16	12
SEWERS (\$1000/YR)	0	0	0	7	7	7	7	7	7
TOTAL (\$1000/YR)	0	0	0	77	77	78	78	71	41
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	315	547	424	294	0	0
PRESENT WORTH (\$1000)	0	0	0	131	161	63	22	0	0
NET O.+M. =	379.333								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	782
O.+M. (\$1000)	379
LAND (\$1000)	107
TOTAL (\$1000)	1268

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN				35	35	35	35	35
PIPES				104	104	104	104	104
TOTAL O.+M.	0	0	0	77	77	78	71	41
TOTAL ANNUAL	0	0	0	217	217	217	182	182

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-15

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	0	1	3	3	3
ANNUAL RUNOFF	0	0	0	14	28	42	56	56
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	0	0	0	40	61	81	81
TREATMENT PLANT	0	0	0	0	17	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	47					160				63
PIPES	88					300				119
RESIDUAL	7									
NET CAPITAL	128									183
										TOTAL

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	3	4	1	1
SLUDGE	(\$1000/YR)	0	0	0	0	1	1	2	2
SEWERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	5	7	5	5
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)		0	0	0	0	48	46	37	0
PRESENT WORTH (\$1000)		0	0	0	0	14	7	2	0
NET O.+M. =		24.3052							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	128
O.+M. (\$1000)	24
LAND (\$1000)	12
TOTAL (\$1000)	165

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					11	11	11	11
PIPES					21	21	21	21
TOTAL O.+M.	0	0	0	0	5	7	5	5
TOTAL ANNUAL	0	0	0	0	39	41	38	38

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN C, CU-16

COMPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	5	6	7	10	13	13
ANNUAL RUNOFF	0	39	78	98	118	157	196	196
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	56	113	143	172	229	286	286
TREATMENT PLANT	0	0	47	59	71	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	124				300					90
PIPES	124				300					90
RESIDUAL	6									
NET CAPITAL	241									
									TOTAL	180

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	13	13	18	6	6
SLUDGE	(\$1000/YR)	0	0	0	4	4	5	7	7
SEWERS	(\$1000/YR)	0	0	0	1	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	19	19	25	15	15
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	81	160	143	106	0
PRESENT WORTH (\$1000)									
		0	0	0	33	47	21	8	0
NET O.+M. = 110.938									

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	241
O.+M. (\$1000)	110
LAND (\$1000)	42
TOTAL (\$1000)	394

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN				21	21	21	21	21
PIPES				21	21	21	21	21
TOTAL O.+M.	0	0	0	19	19	25	15	15
TOTAL ANNUAL	0	0	0	63	63	69	58	58

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS  
NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

STORMWATER TREATMENT PLANT  
PLAN C, CU-17

CORPS OF ENGINEERS - SURVEY SCOPE STUDY

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	1	3	4	5	7	9	10
ANNUAL RUNOFF	0	30	60	74	89	102	138	149
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	43	87	108	129	148	201	217
TREATMENT PLANT	0	0	36	45	54	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	107				260					78
PIPES	1269				3060					918
RESIDUAL	38									
NET CAPITAL	1338									
									TOTAL	996

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	10	10	11		4	4
SLUDGE (\$1000/YR)	0	0	0	3	3	3		5	5
SEWERS (\$1000/YR)	0	0	0	15	15	15		15	15
TOTAL (\$1000/YR)	0	0	0	29	29	30		24	25
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	119	211	196		177	0
PRESENT WORTH (\$1000)	0	0	0	49	62	29		13	0
NET O.+M. =	155.311								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1338
O.+M. (\$1000)	155
LAND (\$1000)	31
TOTAL (\$1000)	1525

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL				18	18	18	18	18
BASIN				221	221	221	221	221
PIPES				29	29	30	24	25
TOTAL O.+M.	0	0	0	269	269	271	265	264
TOTAL ANNUAL	0	0	0	269	269	271	265	264

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

# STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-21

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	3	6	7	9	10
ANNUAL RUNOFF	0	0	0	45	91	108	135	163
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	132	157	197	237
TREATMENT PLANT	0	0	0	0	55	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	79					270				107
PIPES	118					400				159
RESIDUAL	10									
NET CAPITAL	187									
									TOTAL	267

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	0	10	12	4	5
SLUDGE	(\$1000/YR)	0	0	0	0	3	3	4	5
WERS	(\$1000/YR)	0	0	0	0	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	0	16	18	11	13
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	0	122	105	86	0
PRESENT WORTH (\$1000)		0	0	0	0	36	15	6	0
NET O.+M. =	58.6283								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	187
O.+M. (\$1000)	58
LAND (\$1000)	33
TOTAL (\$1000)	279

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					19	19	19	19
PIPES					28	28	28	28
TOTAL O.+M.	0	0	0	0	16	18	11	13
TOTAL ANNUAL	0	0	0	0	64	67	59	61

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C . CU-22

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	0	0	2	4	4	5	7
ANNUAL RUNOFF	0	0	0	30	61	72	91	109
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	0	0	0	89	105	132	159
TREATMENT PLANT	0	0	0	0	37	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	65					220				87
PIPES	118					400				199
RESIDUAL	9									
NET CAPITAL	173									247

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	0	7	8	3	3	3
SLUDGE (\$1000/YR)	0	0	0	0	2	2	3	3	3
SEWERS (\$1000/YR)	0	0	0	0	1	1	1	1	1
TOTAL (\$1000/YR)	0	0	0	0	11	13	8	9	9
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	0	86	75	62	0	0
PRESENT WORTH (\$1000)	0	0	0	0	25	11	4	0	0
NET O.+M. =	41.6483								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	173
O.+M. (\$1000)	41
LAND (\$1000)	22

TOTAL (\$1000) 237

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN					15	15	15	15
PIPES					28	28	28	28
TOTAL O.+M.	0	0	0	0	11	13	8	9
TOTAL ANNUAL	0	0	0	0	56	57	53	54

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-23

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR. STORM RUNOFF	0	1	2	2	2	5	7	7
ANNUAL RUNOFF	0	27	55	55	55	81	108	119
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	40	80	80	80	118	157	173
TREATMENT PLANT	0	0	33	33	33	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	95				230					89
PIPES	962				2320					696
RESIDUAL	29									
NET CAPITAL	1028									TOTAL 765

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	0	6	6	9	3	3	3
SLUDGE (\$1000/YR)	0	0	0	2	2	2	3	3	4
SEWERS (\$1000/YR)	0	0	0	11	11	11	11	11	11
TOTAL (\$1000/YR)	0	0	0	20	20	24	19	19	19
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	0	82	155	151	136	0	0
PRESENT WORTH (\$1000)	0	0	0	34	45	22	10	0	0
NET O.+M. =	113.582								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1028
O.+M. (\$1000)	113
LAND (\$1000)	25
TOTAL (\$1000)	1166

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN				16	16	16	16	16
PIPES				167	167	167	167	167
TOTAL O.+M.	0	0	0	20	20	24	19	19
TOTAL ANNUAL	0	0	0	204	204	208	203	204

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-24

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	5	10	12	15	20	25	25
ANNUAL RUNOFF	0	74	149	186	223	297	372	372
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	108	217	271	325	433	543	543
TREATMENT PLANT	0	0	90	113	136	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	174				420					126
PIPES	124				300					90
RESIDUAL	8									
NET CAPITAL	290									
									TOTAL	216

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT	(\$1000/YR)	0	0	0	24	26	34	12	12
SLUDGE	(\$1000/YR)	0	0	0	8	8	10	13	13
SEWERS	(\$1000/YR)	0	0	0	1	1	1	1	1
TOTAL	(\$1000/YR)	0	0	0	36	36	47	27	27
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)									
		0	0	0	149	293	261	192	0
PRESENT WORTH	(\$1000)	0	0	0	61	86	39	14	0
NET O.+M. =	202.674								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	290
O.+M. (\$1000)	202
LAND (\$1000)	79
TOTAL (\$1000)	572

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN				30	30	30	30	30
PIPES				21	21	21	21	21
TOTAL O.+M.	0	0	0	36	36	47	27	27
TOTAL ANNUAL	0	0	0	88	88	99	79	79

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

## PLAN C, CU-33

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	1	2	3	5	7	8	8
ANNUAL RUNOFF	0	27	54	67	81	108	134	134
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT BASIN	0	39	78	98	118	157	195	195
TREATMENT PLANT	0	0	32	41	49	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT ON LAND

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	103				250					75
PIPES	1124				2710					813
RESIDUAL	34									
NET CAPITAL	1193									838
										TOTAL

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
		<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>	<u>        </u>
PLANT	(\$1000/YR)	0	0	0	9	9	12	4	4
SLUDGE	(\$1000/YR)	0	0	0	3	3	3	4	4
SEWERS	(\$1000/YR)	0	0	0	13	13	13	13	13
<u>TOTAL</u>	<u>(\$1000/YR)</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>26</u>	<u>26</u>	<u>30</u>	<u>22</u>	<u>22</u>
PRESENT VALUE AT BEGIN-									
NING OF PERIOD (\$1000)		0	0	0	107	197	186	160	0
PRESENT WORTH (\$1000)		0	0	0	44	58	27	12	0
NET O.+M. =		143.422							

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	1193
O.+M. (\$1000)	143
LAND (\$1000)	6
TOTAL (\$1000)	1343

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL				18	18	18	18	18
BASIN				196	196	196	196	196
PIPES				26	26	30	22	22
TOTAL O.+M.	0	0	0	240	240	244	237	237
TOTAL ANNUAL	0	0	0	240	240	244	237	237

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

## STORMWATER TREATMENT PLANT

## CORPS OF ENGINEERS - SURVEY SCOPE STUDY

PLAN C, CU-51A+58

	1972	1975	1980	1985	1990	2000	2010	2020
STORMWATER VOLUME (MG)								
1 YR STORM RUNOFF	0	2	5	23	42	48	54	59
ANNUAL RUNOFF	0	32	64	335	606	693	797	867
SLUDGE QUANTITIES (DT/YR)								
SEDIMENT-BASIN	0	46	93	489	884	1011	1163	1265
TREATMENT PLANT	0	0	0	0	0	0	0	0

TREATMENT SCHEME : STORAGE PLUS TREATMENT AT MUNICIPAL PLANT

SLUDGE HANDLING : PERIODIC REMOVAL TO LANDFILL OR RECYCLE

STORAGE BASIN : EARTH

TABLE I : PRESENT WORTH - CAPITAL COSTS - (\$1000)

	PRESENT WORTH	1972	1975	1980	1985	1990	2000	2010	2020	RESIDUAL
BASIN	203			350						69
BASIN	136					460				183
PIPES	1996			3430						685
PIPES	88					300				119
RESIDUAL	41									
NET CAPITAL	2383									TOTAL 1059

TABLE II : PRESENT WORTH - O.+M. COSTS

		1972	1975	1980	1985	1990	2000	2010	2020
PLANT (\$1000/YR)	0	0	2	11	19	22	22	26	28
SLUDGE (\$1000/YR)	0	0	2	12	22	25	25	29	31
SEWERS (\$1000/YR)	0	0	17	17	18	18	18	18	18
TOTAL (\$1000/YR)	0	0	21	40	60	66	66	74	78
PRESENT VALUE AT BEGIN- NING OF PERIOD (\$1000)	0	0	127	207	448	494	494	537	0
PRESENT WORTH (\$1000)	0	0	74	86	132	74	74	41	0
NET O.+M. =	408.044								

TABLE III : TOTAL PRESENT WORTH

CAPITAL (\$1000)	2383
O.+M. (\$1000)	408
LAND (\$1000)	97
TOTAL (\$1000)	2888

TABLE IV : ANNUAL COSTS (\$1000/YR)

	1972	1975	1980	1985	1990	2000	2010	2020
ANNUAL CAPITAL								
BASIN			25	25	25	25	25	25
BASIN					33	33	33	33
PIPES			248	248	248	248	248	248
PIPES					21	21	21	21
TOTAL O.+M.	0	0	21	40	60	66	74	78
TOTAL ANNUAL	0	0	295	314	389	395	402	407

NOTE 1 : ANNUAL COSTS DO NOT INCLUDE PRESENT OUTSTANDING BONDED INDEBTEDNESS

NOTE 2 : AN INTEREST RATE OF 7 PERCENT WAS USED FOR ALL CALCULATIONS

U.S. ARMY CORPS OF ENGINEERS  
BUFFALO DISTRICT

SURVEY SCOPE STUDY  
FOR  
WASTEWATER MANAGEMENT PROGRAM

APPENDIX D  
SUPPLEMENTAL APPENDIX  
PLAN A TO LEVEL 1

HAVENS AND EMERSON, LTD.  
CONSULTING ENVIRONMENTAL ENGINEERS  
Cleveland, Ohio

June, 1973

SUPPLEMENTAL APPENDIX  
PLAN A TO LEVEL 1

This supplemental appendix presents cost data for Plan A only to Level 1 for comparison to the Plan A to Level 2 cost. These two costs when compared will indicate the cost of achieving a higher water quality (Level 2). This illustrates the economic impact of the new Federal "no discharge" legislation. It is important to understand that the "no discharge" or Level 2 criteria is that which has been interpreted by the Corps of Engineers.

This plan has been done to the same degree of effort as was performed to arrive at the cost of Plans A, B & C in the Technical Appendix Phase III.

The development of this plan is the same as Plan A to Level 2 until 1983-85. At this time, all treatment facilities would have attained Level 1 treatment and would be expanded as necessary at Level 1 degree of treatment instead of being upgraded to meet Level 2 standards. Both plans, Plan A to Level 1 and Plan A to Level 2, have the same facilities locations. The locations and degree of regionalization were optimized for the Level 2 cost and may not be, in fact, optimized for the Level 1 cost which has lower unit cost both in capital and operations and maintenance.

Table SA-1 is the same as Table IV-1\* and shows the municipal-industrial wastewater treated by decade. Table SA-2 gives the sludge volumes for disposal. This is comparable to Table IV-4; however, sludge volumes are less for Plan A to Level 1 because of the reduction in the removal of suspended solids and decrease in chemical additions.

\*All tables referred to are in Appendix 1, Plan Formulation Technical - Part II

Each municipal plant in Plan A to Level 1 is described in Table SA-3. Again, this table is comparable to Table IV-7. Basically, the only change is in not upgrading the plants to Level 2. Table SA-4 shows the sludge disposal schemes and is the same as Table IV-10.

Table SA-5 gives the storm runoff volumes. Again, the locations and size of the stormwater facilities do not change and would be the same as described in Table IV-14, except the term advanced stormwater treatment plant is not applicable since only Level 1 treatment is provided.

The costs were computed using the basic data as described above, unit costs as presented in Technical Appendix Phase II, the same techniques used in Technical Appendix Phase III to assure the comparability. The total present worth of Plan A to Level 1 is shown in Table SA-6 compared to the Plans A, B & C to Level 2.

TABLE SA-6

TOTAL PRESENT WORTH  
(In \$1,000 - Factor 7%)

Plan A - Level 1	2,661,759
Plan A - Level 2	3,470,500*
Plan B - Level 2	3,360,600*
Plan C - Level 2	3,227,500*

\*from Table V-1

The total present worth for each municipal plant is shown in Table SA-7 and is comparable to Table V-4. The summation of the individual plant worths with the addition of the contingencies, industrial pretreatment, and storm runoff is shown in Table SA-8 for Plan A to Level 1 as compared to Plan A to Level 2. (See Table V-2, pg. V 12, Plan Formulation Part II)

Total annual costs of Plan A to Level 1 and Plan A to Level 2 are compared in Table SA-9\*. Capital expenditures, annual capital and operation and maintenance costs for each plant for the 1972-2020 time frame are shown on Tables SA-10, 11 and 12. These are comparable to Table V-10. Tables SA-13 and SA-14 compares chemical usage for municipal flows and stormwater flows, respectively, of Plan A to Level 1 and Level 2. Table SA-15 compares electrical requirements of Plan A to Level 1 and Level 2. Table SA-16 compares manpower needs.

\* See Table V-6, pg. V 17, Plan Formulation Part II.

TABLE SA-1

## PLAN A - LEVEL 1

MUNICIPAL/INDUSTRIAL WASTEWATER  
(MGD)

PLANT	1972	1980	1990	2000	2010	2020
<b>Lake Erie</b>						
Cleveland Easterly	125.00	140.00	148.00	158.00	164.00	172.00
Cleveland Westerly	35.91	37.14	39.69	41.22	42.75	45.18
Euclid	14.53	19.11	24.05	28.60	33.63	37.34
Rocky River	7.14	11.11	14.39	16.77	19.72	22.05
Total	182.58	207.36	226.13	244.59	260.10	276.57
<b>Rocky River Basin</b>						
Lakewood	17.11	18.00	19.00	19.00	20.00	21.00
Liverpool	3.08	6.69	9.40	12.24	15.85	20.09
Total	20.19	24.69	28.40	31.24	35.85	41.09
<b>Cuyahoga River Basin</b>						
Akron	71.00	84.09	97.83	111.33	129.03	149.67
Auburn Township	0.17	0.28	0.39	0.53	0.69	0.84
Burton	0.18	0.32	0.45	0.56	0.72	0.91
Butternut Creek	0.24	0.37	0.50	0.66	0.89	1.17
Chardon*	0.03	0.07	0.10	0.13	0.17	0.20
Cleveland Southerly	101.65	129.24	182.52	206.15	225.21	234.20
East Claridon	0.08	0.14	0.21	0.31	0.39	0.48
Kent	5.83	10.68	15.93	20.15	24.65	28.41
Mantua	0.29	0.37	0.47	0.58	0.74	0.86
Middlefield	0.77	1.06	1.42	1.72	2.23	2.70
Randolph	0.20	0.30	0.40	0.50	0.65	0.75
Ravenna	2.05	3.35	5.41	8.53	10.60	12.34
Troy Township	0.09	0.15	0.21	0.29	0.38	0.47
Total	182.58	230.42	305.84	351.44	396.35	433.00
<b>Chagrin River Basin</b>						
Aurora Central	0.22	0.60	1.32	1.73	2.31	2.98
Chagrin E. Branch	0.49	0.72	1.00	1.25	1.58	1.95
Chagrin Falls	0.81	1.35	2.05	2.53	3.08	3.58
Fairmount Road	0.07	0.54	1.55	2.14	2.80	3.40
Fowler's Mill	0.42	0.64	0.88	1.14	1.54	1.98
McFarland Creek	0.18	0.63	1.90	2.66	3.52	4.29
Newbury Township	0.33	0.50	0.69	0.90	1.13	1.54
Willoughby-Eastlake	5.55	7.92	11.61	15.07	18.96	22.27
Total	8.07	12.90	21.00	27.42	34.92	41.99
<b>Interim Plants</b>	20.10	21.21				
<b>Grand Total</b>	413.52	496.58	581.37	654.69	727.22	792.65

\* Chardon is treated out of the Study Area and is not costed in this plan.

TABLE SA-2

## PLAN A - LEVEL 1

SLUDGE VOLUMES FOR DISPOSAL  
(Dry Tons Per Day - DT/Day)

PLANT	1972	1980	1990	2000	2010	2020
<b>Lake Erie</b>						
Cleveland Easterly	84.80	94.98	100.40	107.19	111.26	116.68
Cleveland Westerly	30.88	31.94	34.13	35.45	36.76	38.85
Euclid	9.86	12.96	16.32	19.40	22.81	25.33
Rocky River	3.20	4.98	6.45	7.51	8.83	9.88
Total	128.74	144.86	157.30	169.55	179.66	190.74
<b>Rocky River Basin</b>						
Lakewood	11.61	12.21	12.89	12.89	13.57	14.25
Liverpool	2.09	4.54	6.38	8.30	10.75	13.64
Total	13.70	16.75	19.27	21.19	24.32	27.89
<b>Cuyahoga River Basin</b>						
Akron	48.17	57.05	66.37	75.53	87.53	101.54
Auburn Township	0.12	0.19	0.26	0.36	0.47	0.57
Burton	0.12	0.22	0.30	0.38	0.49	0.62
Butternut Creek	0.16	0.25	0.34	0.45	0.60	0.79
Cleveland Southerly	68.69	87.68	123.82	139.85	152.78	158.88
East Claridon	0.05	0.09	0.14	0.21	0.26	0.33
Mantua	0.19	0.25	0.32	0.39	0.50	0.58
Middlefield	0.52	0.72	0.96	1.17	1.51	1.83
New Kent	5.01	9.18	13.70	17.33	21.20	24.43
Randolph	0.14	0.20	0.27	0.34	0.44	0.51
Ravenna	1.39	2.27	3.67	5.79	7.19	8.37
Troy Township	0.06	0.10	0.14	0.20	0.26	0.32
Total	124.89	158.20	210.29	242.00	273.23	298.77
<b>Chagrin River Basin</b>						
Aurora Central	0.15	0.41	0.90	1.17	1.57	2.02
Chagrin E. Branch	0.33	0.49	0.68	0.85	1.07	1.32
Chagrin Falls	0.55	0.91	1.39	1.71	2.09	2.43
Fairmount Road	0.05	0.37	1.05	1.45	1.90	2.31
Fowler's Mill	0.28	0.43	0.93	1.21	1.63	2.10
McFarland Creek	0.12	0.43	1.29	1.80	2.39	2.91
Newbury Township	0.22	0.34	0.47	0.61	0.77	1.04
Willoughby-Eastlake	2.29	5.37	7.87	10.22	12.86	15.11
Total	3.99	8.75	14.58	19.02	24.28	29.24
<b>Grand Total</b>	<b>271.33</b>	<b>328.56</b>	<b>401.44</b>	<b>451.76</b>	<b>501.49</b>	<b>546.64</b>

TABLE SA-3

## PLAN A - LEVEL 1

## MUNICIPAL/INDUSTRIAL TREATMENT FACILITIES

	1972	1977	1980	1985	2020
Lake Erie Basin					
Cleveland Easterly Euclid	Existing biological treatment plants are upgraded to meet Level 1 standards.			Treatment plants are expanded as necessary.	
Cleveland Westerly	Existing physical-chemical treatment plant is upgraded to meet Level 1 and 2 standards.			Treatment plant is expanded as necessary.	
Rocky River	Physical-chemical component is added to the existing biological treatment plant to meet Level 1 standards.			Treatment plant is expanded as necessary.	
Rocky River Basin					
Lakewood	Existing biological treatment plant is upgraded to meet Level 1 standards.			Treatment plant is expanded as necessary.	
Liverpool	New advanced biological treatment plant is constructed to meet Level 1 standards.			Treatment plant is expanded as necessary.	
Cuyahoga River Basin					
Akron Cleveland Southerly Ravenna	Existing biological treatment plants are upgraded to meet Level 1 standards.			Treatment plants are expanded as necessary.	
New Kent	New physical-chemical treatment plant is constructed to meet Level 1 standards.			Treatment plant is expanded as necessary.	
Auburn Township Burton Butternut Creek East Cleveland Mantua Middlefield Randolph Troy Township	New advanced biological treatment plants are constructed to meet Level 1 standards and to satisfy secondary treatment requirement by 1977.			Treatment plants are expanded as necessary.	
Chardon	A pumping plant and force main are constructed to transmit the sewage to a treatment plant outside the Study Area.				
Chagrin River Basin					
Aurora Central Chagrin East Branch Chagrin Falls Fairmount Road Fowler's Hill McFarland Creek Newbury Township	New advanced biological treatment plants are constructed to meet Level 1 standards.			Treatment plants are expanded as necessary.	
Willoughby-Eastlake	Existing biological treatment plant is upgraded to meet Level 1 standards.			Treatment plant is expanded as necessary.	

TABLE SA-4  
PLAN A - LEVEL 1  
SLUDGE DISPOSAL

1972		1977	1990	2020
<b>Lake Erie</b>				
Cleveland Easterly	Sludge will be piped to Cleveland Southerly for Incineration.			Sludge will be sent via new pipeline to strip-mined land.
Cleveland Westerly	Sludge will be Incinerated.			
Euclid	Sludge will be vacuum-filtered and trucked to agricultural land.			Sludge will be sent via new pipeline to strip-mined land.
Rocky River (Primary)	Sludge will be vacuum-filtered and trucked to agricultural land.			Sludge from Rocky River (primary) and Lakewood will be sent via pipeline to agricultural land.
<b>Rocky River Basin</b>				
Lakewood	Sludge will be flash dried and will be trucked to agricultural land.			Sludge from Rocky River (primary) and Lakewood will be sent via pipeline to agricultural land.
Liverpool	Sludge handling from existing facilities will be phased out by 1977.	Sludge will be sent via pipeline to agricultural land.		
<b>Cuyahoga River Basin*</b>				
Akron	Sludge will be vacuum-filtered and trucked to agricultural land.			
Cleveland Southerly	Sludge will be Incinerated.			Sludge will be sent via new pipeline to strip-mined land.
Bavenna	Sludge will be sent via the existing pipeline to strip-mined land.			
New Kent	Sludge will be Incinerated.			
Auburn Township				
Burton				
Butternut Creek	Sludge handling from existing facilities will be phased out by 1977.			Liquid sludge will be trucked to adjacent agricultural land.
Mantua				
Middlefield				
Randolph				
East Claridon	Sludge handling from existing facilities will be phased out by 1977.			Sludge will be dried in sand drying beds and will be trucked to adjacent agricultural land.
Troy Township				
<b>Chagrin River Basin</b>				
Aurora Central				
Chagrin E. Branch				
Chagrin Falls	Sludge handling from existing facilities will be phased out by 1977.			Liquid sludge will be trucked to adjacent agricultural land.
Fairmount Road				
Fowler's Hill				
McFarland Creek				
Neubury Township				
Willingby-Eastlake	Sludge will be sent via the existing pipeline to strip-mined land.			Sludge will be sent via pipeline to agricultural land.

\* No sludge disposal from Chardon.

TABLE SA-5

PLAN A - LEVEL 1

STORM RUNOFF  
AVERAGE ANNUAL VOLUMES TO BE TREATED  
(Millions of Gallons per Year - MG/Year)

<u>Type of Treatment Facility</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
Advanced Stormwater Treatment Plant	8,422	27,302	34,700	38,428	41,260
Municipal Sewage Treatment Plant	<u>6,976</u>	<u>22,848</u>	<u>25,871</u>	<u>28,448</u>	<u>29,997</u>
TOTAL	15,398	50,150	60,571	66,876	71,257

TABLE SA-7

TOTAL PRESENT WORTH  
(In \$1,000 - Factor 7%)

<u>Plant</u>	<u>Plan A - Level 1</u>	<u>Plan A - Level 2</u>
Randolph	2260	2609
New Kent	27231	28328
Burton	2559	2956
Mantua	2309	2767
Butternut Creek	3201	3730
Chardon	258	241
East Claridon	973	1208
Troy Township	897	1127
Auburn Township	2207	2623
Ravenna	13174	15864
Aurora Central	5696	6771
Fairmount Road	5886	7092
Fowlers Mill	4722	5545
Newbury Township	2978	3648
Chagrin Falls	7682	9020
Chagrin East Branch	5280	6154
Liverpool	33737	38221
Middlefield	5661	6737
McFarland Creek	9372	10799
Akron	132018	161575
Euclid	35826	43744
Lakewood	32988	38688
Rocky River	21399	22687
Willoughby-Eastlake	19502	24221
Easterly	176860	221569
Southerly	273851	323350
Westerly	81109	84303
Interim Plants	36818	36818
Strip-Mine Pipeline	<u>10232</u>	<u>10232</u>
TOTAL	956686	1122627

TABLE SA-8

TOTAL PRESENT WORTH  
(In \$1,000 - Factor 7%)

Treatment Category	PLAN A - LEVEL 1			PLAN A - LEVEL 2		
	Base Total	Contingency	Grand Total	Base Total	Contingency	Grand Total
Industrial Pretreatment	517,300	122,400	639,700	820,700	193,100	1,013,800
Municipal/Industrial	956,686	234,064	1,190,750	1,122,700	272,300	1,395,000
Storm Runoff	645,732	185,577	831,309	826,900	234,800	1,061,700
TOTAL	2,119,718	542,041	2,661,759	2,770,300	700,200	3,470,500

**TABLE SA-9**

**ANNUAL CAPITAL AND OPERATION AND MAINTENANCE COSTS**  
(In \$1,000 - Factor 7%)

	<u>1972</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
<b>PLAN A - LEVEL 1</b>						
<b>Municipal/Industrial</b>						
Capital	226	25,432	44,304	66,795	66,329	65,616
O & M	30,581	39,930	43,254	45,918	51,180	56,136
<b>Storm Runoff</b>						
Capital	0	51,991	63,817	69,326	69,303	69,319
O & M	0	7,111	9,412	11,217	12,269	12,943
<b>Contingencies</b>	<u>6,183</u>	<u>32,634</u>	<u>42,968</u>	<u>52,261</u>	<u>53,377</u>	<u>54,294</u>
<b>TOTAL</b>	<b>36,990</b>	<b>157,098</b>	<b>203,755</b>	<b>235,517</b>	<b>242,458</b>	<b>258,308</b>
<b>PLAN A - LEVEL 2</b>						
<b>Municipal/Industrial</b>						
Capital	300	25,600	60,200	80,100	79,700	79,700
O & M	31,000	40,300	58,300	63,000	70,300	77,000
<b>Storm Runoff</b>						
Capital	500	53,200	91,100	100,500	100,400	100,400
O & M	0	7,100	18,200	22,000	24,200	25,700
<b>Contingencies</b>	<u>6,400</u>	<u>33,100</u>	<u>60,700</u>	<u>71,200</u>	<u>72,900</u>	<u>74,500</u>
<b>TOTAL</b>	<b>38,200</b>	<b>159,300</b>	<b>288,500</b>	<b>336,800</b>	<b>347,500</b>	<b>357,300</b>

TABLE SA-10

## PLAN A - LEVEL 1

CAPITAL EXPENDITURES  
(in \$1,000)

PLANT	1972	1975	1980	1985	1990	2000	2010	2020	TOTAL	RESIDUAL
Randolph	8	1007	150	-	778	155	816	180	3,094	548
New Kent	520	12,040	-	-	5,306	7,240	-	5,306	30,412	6,172
Burton	9	977	515	338	1,024	155	1,280	185	4,483	771
Mantua	-	920	150	-	845	155	920	200	3,190	611
Butternut Creek	12	1,445	623	-	1,206	180	1,065	200	4,731	836
Cardon	-	-	400	-	-	-	50	-	450	89
East Cleridon	5	487	15	-	493	25	352	30	1,407	319
Troy Township	5	367	15	-	476	25	352	30	1,270	344
Auburn Township	8	778	486	-	931	155	818	175	3,351	605
Ravenna	-	6,046	-	-	6,170	1,600	4,270	-	18,086	4,677
Aurora Central	30	2,104	1,310	-	3,460	325	2,279	275	9,783	2,223
Fairmount Rd.	-	3,046	410	-	3,144	345	2,506	260	9,711	2,066
Fowlers Mill	20	2,564	205	-	1,752	255	1,685	280	6,771	1,245
Newbury Township	15	1,044	-	-	1,964	-	1,044	-	4,067	1,206
Chagrin Falls	179	3,246	871	-	720	1,235	3,311	705	10,267	2,594
Chagrin E. Branch	20	2,202	762	-	1,908	225	1,828	310	7,255	1,451
Liverpool	-	21,800	500	3,834	9,545	575	8,700	1,750	46,704	9,367
Middlefield	27	2,480	392	-	1,974	305	2,283	400	7,861	1,630
McFarland Creek	-	6,643	460	-	3,095	400	2,838	280	13,716	2,467
Akron	3,244	16,882	1,200	43,555	3,600	39,000	16,180	63,126	186,787	29,974
Euclid	1,110	7,930	-	60	10,510	13,900	9,530	-	43,040	12,067
Lakewood	750	8,605	-	60	3,160	11,400	6,630	750	31,355	9,374
Rocky River	400	115	2,010	110	8,990	9,600	1,085	400	22,710	5,404
Willoughby-Eastlake	-	1,760	7,906	-	6,274	6,835	6,040	-	28,815	9,313
Easterly	-	19,500	1,458	-	15,800	99,853	29,500	-	166,111	66,403
Southerly	2,780	89,665	23,975	27,300	34,736	110,130	69,900	88,000	446,436	113,218
Westerly	-	38,650	-	-	19,247	38,650	-	-	96,547	10,424
Interim Plants	33	14,002	0	0	0	0	0	0	14,035	0
Strip-Mine Pipeline	0	900	400	21,000	0	2,000	2,507	900	27,780	10,810
TOTAL	9,175	267,205	44,213	96,257	147,113	944,753	177,762	163,742	1,250,195	305,408

TABLE SA-11

## PLAN A - LEVEL 1

ANNUAL CAPITAL COSTS  
(In \$1,000/Yr. - Factor 7%)

<u>Plant</u>	<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
Randolph	-	78	88	114	150	160	175	176
New Kent	-	1006	1006	1006	1463	1463	1463	1463
Burton	-	68	105	134	209	228	228	228
Mantua	-	71	82	82	147	158	174	174
Butternut Creek	0	110	155	156	251	264	287	287
Chardon	-	-	29	29	30	30	30	30
East Claridon	-	38	39	40	79	81	82	82
Troy Township	-	28	30	30	76	78	79	79
Auburn Township	-	61	96	96	168	179	195	195
Ravenna	-	463	463	462	938	1039	1039	1039
Aurora Central	2	164	163	258	519	544	577	577
Fairmount Road	-	229	259	261	500	526	559	558
Fowlers Mill	-	196	210	211	347	365	394	394
Newbury Township	1	82	82	83	231	232	232	231
Chagrin Falls	12	261	325	326	518	609	664	664
Chagrin E. Branch	1	197	252	253	385	402	428	327
Liverpool	-	1613	1613	1920	2661	2703	2751	2751
Middlefield	0	186	216	217	369	392	420	419
McFarland Creek	-	491	525	526	762	791	827	827
Akron	8	1492	1624	4976	5236	8246	8246	8246
Euclid	-	686	708	714	1524	2449	2448	2395
Lakewood	-	726	735	742	982	1707	1714	1715
Rocky River	-	29	202	210	883	1542	1551	1551
Willoughby-Eastlake	-	133	744	745	1210	1626	1679	1679
Easterly	-	2525	2517	2526	3743	11432	11432	11432
Southerly	200	7007	8734	10825	13414	21894	21895	21336
Westerly	-	3316	3256	3316	4802	4802	4802	4802
Interim Plants	2	1080	1080	1080	1080	1080	2	2
Strip-Mine Pipeline	<u>0</u>	<u>65</u>	<u>94</u>	<u>94</u>	<u>1627</u>	<u>1773</u>	<u>1956</u>	<u>1956</u>
TOTAL	226	22401	25432	31432	44304	66795	66329	65616

TABLE SA-12

## PLAN A - LEVEL 1

ANNUAL OPERATION AND MAINTENANCE COSTS  
(In \$1,000/Yr.)

<u>Plant</u>	<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
Randolph	32	57	66	80	93	117	141	157
New Kent	487	713	916	1065	1186	1494	1823	2097
Burton	28	56	71	87	103	126	153	184
Mantua	45	67	77	91	104	126	150	169
Butternut Creek	37	62	82	95	110	139	172	218
Chardon	-	-	2	2	2	2	2	2
East Claridon	13	19	24	31	38	55	68	84
Troy Township	14	20	24	31	36	50	65	78
Auburn Township	26	50	61	72	91	119	144	168
Ravenna	210	284	351	418	467	732	908	1056
Aurora Central	32	77	119	170	216	266	348	448
Fairmount Road	9	64	103	176	240	311	400	489
Fowlers Mill	66	108	132	147	158	192	252	326
Newbury Township	52	82	102	117	134	163	198	271
Chagrin Falls	107	172	225	257	303	359	435	512
Chagrin E. Branch	76	120	150	167	179	211	260	322
Liverpool	298	576	782	872	922	1176	1508	1882
Middlefield	110	160	194	214	229	263	336	412
McFarland Creek	23	90	129	218	291	375	488	596
Akron	4688	6158	6681	7098	6105	6944	8044	9327
Euclid	1146	1535	1740	1921	1592	1893	2226	2471
Lakewood	1388	1725	1771	1769	1448	1448	1524	1598
Rocky River	638	920	1120	1228	1342	1540	1782	1975
Willoughby-Eastlake	264	441	657	807	1070	1382	1630	1910
Easterly	8979	9517	10063	9654	9206	9828	10201	10698
Southerly	7301	8391	9502	10661	11649	13118	14302	14861
Westerly	2621	2666	2771	2804	2897	3009	3120	3298
Interim Plants	1891	2506	1975	2306	2633	0	0	0
Strip-Mine Pipeline	0	35	40	45	410	480	500	526
TOTAL	30581	36671	39930	42603	43254	45918	51180	56136

TABLE SA-13

CHEMICAL REQUIREMENTS - MUNICIPAL FLOWS  
(TONS/DAY)

	<u>Chlorine</u>	<u>Alum</u>	<u>Polymer</u>	<u>Methanol</u>	<u>Lime</u>
<u>Plan A, Level 2</u>					
1980	35.7	23.1	1.0	-	133.0
1990	38.6	31.5	1.2	108.4	175.6
2000	43.1	35.2	1.4	121.0	196.0
2010	48.0	39.0	1.5	134.4	217.8
2020	52.6	42.5	1.7	146.4	238.0
<u>Plan A, Level 1</u>					
1980	35.7	23.1	1.0	-	133.0
1990	43.0	28.6	1.2	-	162.8
2000	48.0	32.0	1.4	-	181.6
2010	53.4	35.5	1.5	-	202.0
2020	58.4	38.7	1.7	-	220.5

TABLE SA-14

CHEMICAL REQUIREMENTS - STORMWATER FLOWS  
(TONS/DAY)

	<u>Chlorine</u>	<u>Alum</u>	<u>Polymer</u>	<u>Methanol</u>	<u>Lime</u>	<u>Granular Activated Carbon</u>	<u>Powdered Activated Carbon</u>
<u>Plan A, Level 2</u>							
1980	2.6	2.7	.1	-	12.7	-	-
1990	8.9	5.2	.4	12.6	27.7	1.0	32.7
2000	9.6	5.9	.5	14.4	31.1	1.2	41.9
2010	10.1	6.5	.5	16.0	33.5	1.3	45.0
2020	10.2	6.7	.6	17.0	34.6	1.5	49.9
<u>Plan A, Level 1</u>							
1980	2.6	2.7	.09	-	12.7	-	-
1990	3.6	3.3	.12	-	16.3	-	-
2000	4.0	3.8	.14	-	18.4	-	-
2010	4.3	4.2	.15	-	20.3	-	-
2020	4.5	4.5	.16	-	21.4	-	-

TABLE SA-15

POWER REQUIREMENTS, MEGA WATT HOURS PER DAY

	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>
Plan A (Level 2)	1362	1788	2028	2229	2414
Plan A (Level 1)	1362	1548	1764	1944	2105

TABLE SA-16

MANPOWER REQUIREMENTS

MUNICIPAL PLANTS

	<u>Engineers</u>	<u>Chemists</u>	<u>Supervisors</u>	<u>Operators</u>	<u>Others</u>	<u>Total</u>
Plan A (Level 2)	40	20	70	210	670	1010
Plan A (Level 1)	34	17	58	175	560	844

STORMWATER PLANTS

	<u>Engineers</u>	<u>Chemists</u>	<u>Supervisors</u>	<u>Operators</u>	<u>Others</u>	<u>Total</u>
Plan A (Level 2)	15	30	55	200	1200	1500
Plan A (Level 1)	13	25	46	166	1000	1250

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-18